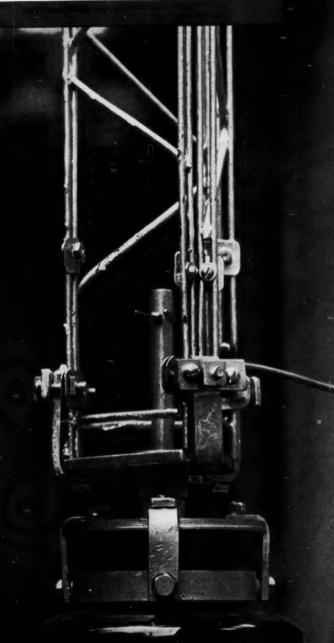
RADIO



THIS MONTH
RADIO'S 1939 DX CONTEST RESULTS
STEP-BY-STEP ROTARY CONSTRUCTION
CARRIER REMOTE CONTROL DETAILS
8-WATT 112-MC, MOBILE TRANSCEIVER

The Worldwide Authority of Amateur and Shortwave Radio

June 1940

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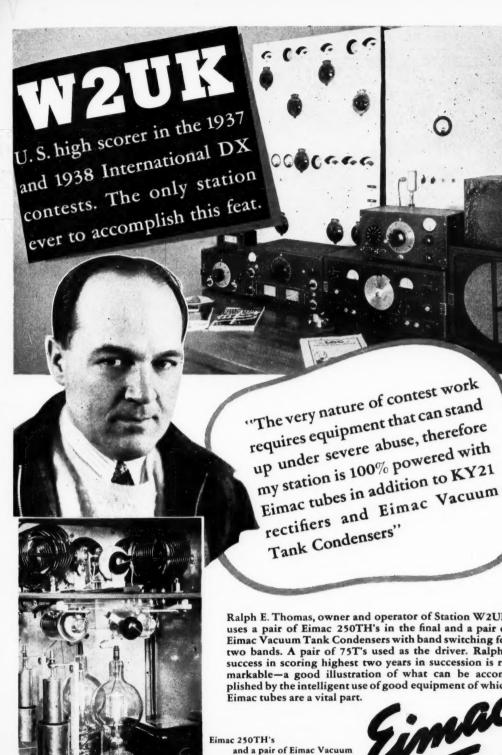
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Ruenor BulldRalph E. Thomas, owner and operator of Station W2UK uses a pair of Eimac 250TH's in the final and a pair of Eimac Vacuum Tank Condensers with band switching for two bands. A pair of 75T's used as the driver. Ralph's success in scoring highest two years in succession is remarkable-a good illustration of what can be accomplished by the intelligent use of good equipment of which

Tank Condensers make up the final. Eimac KY21 tubes for the rectifier and 75T's for the driver.

EITEL-McCULLOUGH, Inc. San Bruno, Calif.

Past Present and Prophetic

QRO Transceiver

When Editor Smith decided that his car needed a 2½-meter transceiver, he went about it in a big way and used an honest-to-goodness transmitting tube as the detector-oscillator. Just to prove that the rig really worked he took it up into the hills in back of Santa Barbara on a recent Sunday and nonchalantly broke the 2½-meter dx record by working W6OIN in San Diego, an airline distance of approximately 175 miles. As an anticlimax he then made a couple of 75-mile contacts with Los Angeles. The Big Bertha transceiver is described on page 28.

Golden Rule for V.F.O.'s

Accompanying the manufactured version of the v.f. crystal oscillator described on page 31 is the following paragraph, which, we think, could well be copied and pasted on the panel of every v.f.o.

"In using a variable frequency exciter, common courtesy should be applied to prevent unnecessary interference with other operators. Thoughtless use of a variable frequency exciter will only rob others of pleasures to which they are rightfully entitled."

Change of Scenery

Tired of looking at the same old wall or out of the same old window while operating the transmitter? On page 13 Waller describes a remote-control unit which requires nothing more than a 110-volt a.c. outlet for complete transmitter control from anywhere in the house. The advantages of an operating convenience of this type are too obvious to require further comment.

Results

In the DX Department you will find the official results of our DX Contest of last November-December. The turnout for this, our

*The following Sunday this was shoved out to 200 miles, using same equipment, by perching on a peak farther north and working the same station. first venture into contest sponsorship, was most gratifying. However, we were more than a little surprised by the lack of entries in the more-than-one operator divisions. In practically every call area and country a single contact by a station "admitting" more than one operator would have netted a certificate. Plans for this year's contest are well under way and, since we have had practically unanimous approval of the rules expressed by the contestants, no drastic changes are contemplated.

Portamobile

With summer approaching as this is being written, portable and mobile equipment would seem to be in order. Therefore with vacations and Sunday outings in mind we recommend Driml's pint-sized mobile rig shown on page 40 and Striker's combined portable transmitter and station exciter on page 33.

F.M. Moves Down

Elsewhere in this issue will be found a formal announcement of the opening of a portion of the 56-Mc. band to frequency modulation. Just exactly what the Commission means by "frequency modulation" we haven't yet been able to find out. Presumably, intentional frequency modulation—as contrasted to the unintentional type caused by amplitude modulation of a self-controlled oscillator—is what is implied. We sincerely hope that this is the case, since a return of the modulated self-controlled rig and the transceiver to 56 Mc. could hardly be classed as amateur "progress."

Of late a goodly amount of office gab has centered around the possibility of narrow-band frequency modulation on the lower frequency bands. This is an especially interesting subject since theory indicates that with a deviation ratio of 1 (frequency swing each side of center equal to frequency of impressed audio) the second and higher-order sideband components are of insignificant strength, while an improvement in signal-to-noise ratio of 1.7 to 2 times (depending upon the type of noise) over conventional amplitude modulation is obtained.

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TRA

The most appealing part of this business is that a couple of receiving tubes will modulate the transmitter, be it ten watts or a thousand. Unfortunately, fading plays havoc with f.m., and could well nullify its laboratory advantages on the lower frequencies. Until the F.C.C. sees fit to open part of one of the lower frequency bands for actual "on the air" experimentation we can't do much about it.

50 Vs. 60 Cycles

On page 17 Technical Editor Dawley describes the wide range audio oscillator we [Continued on Page 82]

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TAKES GUESSWORK OUT OF SELECTING TRANSFORMERS

HORDARSON



"How to Determine Correct Driver Transformer Ratio" and "Multi-

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of great technical value to Ama-

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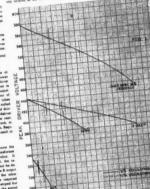
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HORDARSON ELEC. MFG. CO.

45th anniversary

RANSFORMER SPECIALISTS SINCE 1895

RADIO

The publishers assume no responsibility for statements made he contributors and correspondents, nor does publication indicate thereoj.

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THE WORLDWIDE TECHNICAL AUTHORITY ON AMATEUR, SHORTWAVE, AND EXPERIMENTAL RADIO

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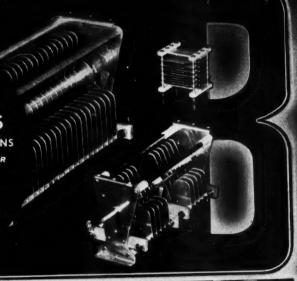
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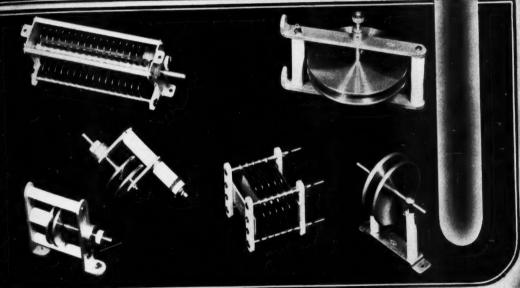
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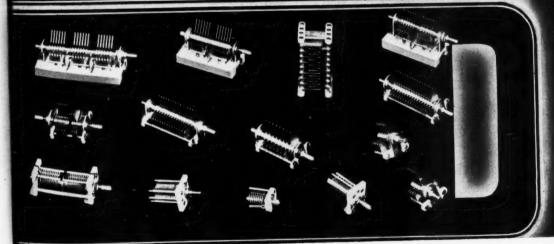
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Cleveland, Ohio

• W6FFF attaching one of the radials to his "bandswitching", ground-radials to his "bandswitching" meter for $2^{1/2}$ meter plane vertical.

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PUKA PINNACLE

By A. W. GREENLEE, * K6NYD, Lt. (jg) U. S. N.

The shades of Captain Bligh, "Mr. Christian," and their heroic companions undoubtedly recoiled in new torment early last March when portable KE6 went on the air from an unknown microscopic island far out in the Pacific Ocean and shattered anew the legendary silence of that vast and lonely section widely styled "the South Seas." To be exact, it was late in the afternoon of March 13, 1940 when Roger Parnell and I—after many hours of feverish construction and sometimes crude contrivance—crossed our fingers, snapped a switch, and put a CQ on the air. A few seconds later our faces stretched irrepressibly into broad grins, for answers began to roll in. Our glow of pleasure grew as we counted off the stations calling until we were practically incandescent.

W6CQS near Oakland, California was our first contact, and the QSO with him helped us hang up some kind of a first, since our part

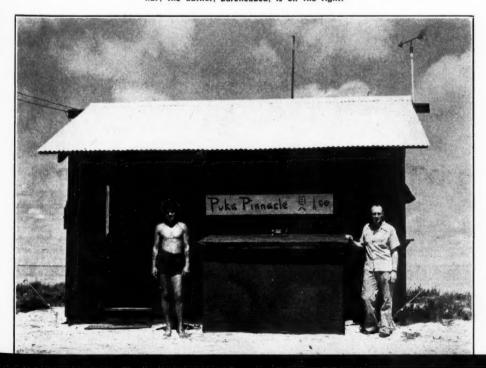
of the world... but perhaps we should pause long enough to start at the beginning with an explanation that what follows is an account of a radio amateur's adventure in a comparatively unknown district and a description of his attempts to familiarize amateurs with the

In the first place the whole thing began as a typical "postman's holiday." I am, first and last, a radio ham; but in between the U. S. Navy pays my salary, and I reciprocate by serving as a line officer in the aviation branch where in some mysterious way communication duties constantly fall to me.

It was to get away from it all—all the gripes and growls which usually pour like a shower of harmless sparks on the head of a squadron radio officer—that I prepared to absent myself for a few days while most of the planes were out on advance base operations. But what motivated my packing up a 2000-foot coil of antenna wire and my handy old junk box I'm not quite sure myself. Any-

^{* 1001 18}th Ave., Honolulu, T. H.







The regular assignment plane and crew of the author (extreme left); it was a plane similar to this in which they flew to Johnston Reef.

how, this gear was among my effects when they were stowed aboard a plane in which this time I was to fly as a semi-passenger, and some good natured razzing from the boys followed their discovery of what they termed "Bill's emergency kit."

We took off at dawn on the thirteenth of March, and the morning hours passed as pleasantly as the white fluffy clouds beneath us. In loose formation the planes hummed their way southwestward from the Hawaiian Islands. By mid-day the upthrust bits of ocean floor known as Johnston Reef or Johnston Island took shape out of the haze ahead, and shortly afterwards we were skimming wave tops alongside a barrier reef as the pilot cautiously settled the plane for a landing. There came the zip-swish of fast water beneath the hull and we were on.

Quickly assembling my personal baggage, I was soon set ashore on a low sandy island which reminded me at once of the old North Dakotan's remark to the effect that you could look farther and see less in his state than in any other state in the union. Nevertheless, it was just what I wanted. Tropical fish abounded in the lagoon inside the reef; the trade winds blew steady and cool all the way from

the North American coast; and after tomorrow, when the planes took off again, I would have four days of uninterrupted peace and quiet with plenty of time for fishing and tinkering.

Companionship was available too, for as I made my way up the beach from where supplies, baggage, and myself had been landed, I saw Roger Parnell. Young, friendly, courteous, Mr. Parnell was to be associate, guide, and even student during my stay. A member of the widely scattered and unsung band of U. S. weather station operators, he was glad of the opportunity to talk with an outsider. He explained that supply ships were so distressingly infrequent, he had thought of offering a bounty for all English speaking humans brought to him alive.

As we proceeded up the beach toward his establishment, he explained that Sand Island, where we were, was the most habitable spot in the area. Johnston Island, about a mile to the westward, while much larger is uninhabited and inaccessible. All about us as we walked were the "nests" of sea fowl. Shallow depressions are scooped out of the sand by terns, booby, frigate and other varieties of

[Continued on Page 89]

Simplified Carrier Operated

REMOTE CONTROL

By L. C. WALLER, * W2BRO

An improved system using the house wiring as a transmission line for operating filament, plate, and keying relays.

Many radio amateurs sooner or later encounter circumstances which make it highly desirable to operate their c.w. rigs from a remote position. For example, in the hot summer months, a rig located on the second floor of a two-story house (or still worse, in the attic) may be "too hot to handle." The room temperature normally may be much too high for comfort, but after a transmitter of any appreciable power has been dissipating its usual quota of heat for a short time, the room is likely to become quite unbearable. How about moving the receiver and the operating switches of the transmitter to a table in that nice cool cellar? Or, perhaps, to that relatively cool rear bedroom on the first floor? Such a move can readily be accomplished without stringing unsightly relay wires hither and yon.

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In a recent article¹ the writer described a simple, carrier-operated remote-control circuit which employs the house a.c. wiring circuit as a transmission line for relay operation. This system is quite workable but, as was pointed out at the time, possesses a number of disadvantages. An improved arrangement was promised for a later date and will now be described.

The new remote-control system permits the independent operation of three relays by means of a single, 300-kc. Hartley oscillator. This small control-oscillator unit can be plugged in any a.c. outlet in the house, as long as the transmitter is powered from an a.c. supply line which emanates from a common power-line-transformer winding. This is, of course, the usual condition encountered. Thus, the carrier-operated system does not tie the

operating position down to one particular spot in the house. That cool cellar, the rear bedroom, or any other room can be quickly utilized, as may prove desirable at any given time.

In order to understand the operation of the new system, the reader should first refer to the previous article¹—especially to that part which describes the operation of the gas triode, type OA4-G. In addition to one OA4-G, the new relay unit (to be located at the transmitter) also employs two of the new 2051's. The latter tube type is a sensitive gas "tetrode" designed especially for grid-controlled rectifier service. Its average control characteristics are shown in the curves of figure 1. The socket connections and electrode arrangements of both the OA4-G and the 2051 are shown in figure 2.

The remote-control relay unit is not quite as simple as the control oscillator and will, therefore, be described last. It is necessary to say, however, that its selector circuits operate on a variation in amplitude of the r.f. signal impressed across the a.c. line by the remote oscillator. In the normal operating cycle, three types of r.f. signal are required, in this order:

1) A high-amplitude signal of short duration.

A low-amplitude signal which can be switched on and left on.

 A medium-amplitude signal which can be keyed.

These requirements can easily be met by the simple Hartley oscillator shown in figure 3. The 50L6-GT, which is operated as a triode with its screen tied to its plate, receives both heater and plate power directly from the a.c. line.

The tank coil L₂ is inductively coupled to the a.c. line through a low-impedance second-

^{*} RCA Mfg. Co., Inc., Harrison, N. J.

¹ Waller, "Carrier-Operated Remote-Control Circuits," RADIO, Nov., 1939.

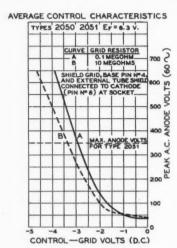


Figure 1. Operating characteristics for the 2051 gaseous tetrode.

ary winding L_1 . The oscillator frequency is not critical and can be in the order of 50 to 400 kc. With the circuit constants shown in figure 3, the frequency is about 300 kc. L_1 consists of four turns wound around L_2 at the point where the latter is tapped; that is, at the point of zero r.f. potential. Blocking condenser C_1 prevents L_1 from shorting the a.c. power line and also by-passes the plate-tank circuit at its r.f. voltage node. Grid bias for the oscillator is obtained from grid leak R_1 .

Resistors R₂ and R₃ are not cathode bias resistors, but serve merely as series resistances in the -B lead to provide variations in the amplitude of the r.f. carrier. In figure 4, A, B, and C show the waveform and relative amplitude of the carriers impressed on the a.c. line. The large carrier C is obtained for a short interval when push-button switch S₁ is depressed and then released. S, serves to short out R₂ and S₂, thus placing the full a.c. line voltage on the plate of the oscillator. The large, momentary signal obtained in this manner triggers the OA4-G (see figure 5), operates relays Z₁ and Z₂, and thus turns on all transmitter filament supplies, as well as the heaters of the 2051's in the relay unit.

Toggle switch S_2 is next closed, so that the cathode of the 5OL6-GT is returned to —B through a 20,000-ohm resistor, R_2 . This resistor greatly reduces the oscillator plate voltage and produces a very small carrier, as shown in figure 4A. Carrier 4A is used to trigger relay tube V_2 (see figure 5), which operates relay Z_3 and turns on all transmitter plate supplies.

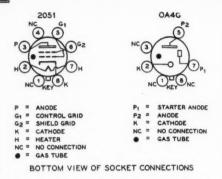


Figure 2. Socket connections for the OA4-G and 2051 tubes.

The rig is now ready to be keyed by K (figure 3), which shunts R_2 with a 4000-ohm resistor, R_3 . This operation increases the oscillator plate voltage so that carrier B (figure 4) is obtained. It should be noted that carrier B represents merely a sizable *increase* in carrier A. That is, when the key is up, carrier A still remains as long as switch S_2 is closed. Every time the key is closed, carrier B triggers V_3 and relay Z_4 , the latter being connected in the keyed circuit of the transmitter.

The operation of the remote-control oscillator is quite simple and dependable. No difficulty whatever should be experienced in making it "perk," provided the recommended circuit constants are employed. The oscillator plate and grid current values for each of the three carrier amplitudes are as follows:

Carrier	D.C. Plate Ma.	D.C. Grid Ma.
A	2.2	0.8
В	5.2	2.0
C	8.0	3.2

These current values will vary considerably, depending on the impedance of the a.c. line at the remote position where the oscillator is located. If the plate current is too low, an impedance mismatch between L_1 (figure 3) and the a.c. line may be the cause. In some installations, therefore, it may be found advisable to try one or two turns more, or less, for L_1 . In this manner, the impedance match can be improved so that a stronger signal will be delivered to the line.

The circuit for the remote-control relay unit is shown in figure 5. The OA4-G circuit is essentially like the one previously described. Inductance L₃ and condenser C₆ comprise a series-tuned circuit shunted across the a.c. line. Trimmer C₇ serves to tune the circuit to resonance with the 300-kc. frequency of the oscillator. The carriers pictured in figure 4

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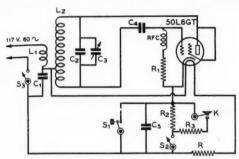
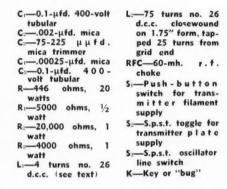


Figure 3. The 300-kc. remote control oscillator.



are as viewed on a cathode-ray oscillograph connected directly across L_3 . Carrier C actually looks like D when the OA4-G is firing, the distortion being due to the intermittent loading of L_3 by the OA4-G. The oscillographic patterns offer a convenient, though not essential, method of indicating when L_3 C_6 are in resonance with the oscillator frequency.

The 60-cycle a.c. voltage from the junction of R4 and R5 has an amplitude which is just too small to trigger the starter anode of the OA4-G. Thus, when the high-amplitude carrier C comes on, the large r.f. voltage built up across L_3 adds to the a.c. voltage across R_5 and triggers the OA4-G. The tube acts as a half-wave rectifier, passing a d.c. anode current of about 20 ma. through the 2000ohm winding of relay Z1. This relay operates stepping relay Z2, which closes and stays closed, even when carrier C has been removed. Relay Z, is necessary because stepping relay Z₂ requires a considerable amount of power to operate-much more than the OA4-G is capable of handling. Z₂, when closed, turns on the transmitter filaments and also the heaters of V2 and V3—the 2051's.

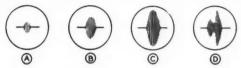
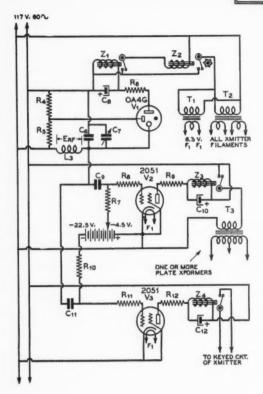


Figure 4. Oscillographic patterns of the 300-kc. carrier as it is received at the relay unit. Carrier (C) is distorted as in (D) when the OA4-G is firing. Carrier (C) turns on the transmitter filaments, (A) the plate supplies, and (B) keys the rig. (C) also closes the transmitter down after a QSO session. The transmitter can be controlled from any room in the house.

After a few seconds delay—which gives the 866's in the transmitter power supply a chance to "warm up"—the cathodes of the 2051's are hot and ready to operate. Carrier B is next applied by S₂ (figure 3). The small r.f. signal thus appearing across L₃ is not enough to trigger the OA4-G, but it does trigger V₂—through C₉ and R₈. The grid of V₂ is biased only 4.5 volts negative from a small C battery. Relay tube V₃ is biased at —22½ volts, and is not affected by small carrier A. When V₂ "fires," it passes a pulsating d.c. current of 35 to 40 ma. through relay Z₃, which operates to turn on the transmitter plate supplies—both low and high voltage. The rig is now ready for keying.

Next, the remote oscillator key boosts the line carrier from A to B; this increased signal is still too small to fire V_1 , but it fires V_3 . The plate-supply relay tube, V_2 , continues to fire, of course, since carrier B is larger than carrier A. Thus relay Z_3 holds down, as desired, while relay Z_4 keys the transmitter

-as rapidly as a fast bug will go! After a transmission, S₂ is opened at the remote oscillator. There is then no 300-kc. carrier to cause harmonic interference on the station receiver. The mechanical locking of stepping relay Z₂ keeps the transmitter filaments hot, however, and the rig is ready to go again when S2 is closed for the next transmission. When the operator is ready to close down the transmitter completely, he has only to give push-button switch S₁ a quick poke. This delivers carrier C, fires V₁, V₂, and V₃ for about the time interval of one dot, and causes stepping relay Z_2 to open and stay open. Thus the heaters of V_2 and V_3 are turned off, along with all transmitter filaments. Subsequent closing of S₂ and the key will produce no action, because the cathodes of V_2 and V_3 are cold. Just as a check to prove that Z_2 is open, the operator should close S2 and the key. If the rig is turned off properly, the transmitter signal will not be heard in the station receiver.



This remote-control relay unit, as previously explained, employs three "selector" circuits, each of which operates on a different carrier amplitude. Relay tubes V₂ and V₃ operate independently by virtue of the voltage differential between their respective bias voltages. As shown in figure 5, this bias differential is 22.5 - 4.5, or 18 volts. The steep control characteristic of the 2051 (see figure 1) indicates that a considerably smaller bias differential might be used. So far as the sensitivity and uniformity of the 2051's are concerned, a bias differential of only 2 or 3 volts may be adequate. However, in actual practice, it was found difficult to control the differential in the amplitudes of the 300-kc. carrier within such small limits.

The amplitude of the carrier voltage E_{rf} measured across L_3 (figure 5) is affected by factors other than the oscillator plate voltage. Of these factors, the most important are:

- 1) Variations in the input impedance of the a.c. power line at various a.c. outlets in the house.
- 2) Variations in the load applied to the a.c. line.
 - 3) Line voltage surges.

Figure 5. Three-circuit remote control unit for c.w. transmitters. No power is required by the relay tubes when the transmitter is not in use. The resistance of R₅ must be low enough to prevent line-voltage surges from firing the OA4-G. Otherwise the transmitter may be turned off when a surge happens to coincide with a closing of the key.

Co-.002-ufd, mica Rs-50,000 ohms, 1/2 C1-75-225 µfd. mica watt R₉---250 trimmer ohms. Cs-25-µfd. 50-volt watt R10-100,000 ohms. electrolytic 1/2 watt R₁₁—20,000 ohms, 1/2 C .-- 0.1-µfd. 400-volt tubular C10-8-µfd. 150-volt watt T .- 6.3 v 1 a. fila. electrolytic C11-0.1-µfd. 400ment transformer T2-Transmitter filavolt tubular C12-8-µfd. 150-volt ment supplies Ta-Transmitter plate electrolytic supplies R-15,000 ohms, 1 Z₁, Z₃, Z₄—S.p.s.t. watt a.c. relay, 2000-ohm coil R .--- 8000 ohms. watt Re—500 Z2-3.p.s.t. mechanically locking, elecwatts R:--100,000 ohms. trically reset a.c. 1/2 watt relay, 200-ohm coil

The first factor is apt to cause more variation in E_{rf} than the other two, but none will be troublesome if a suitably large bias differential is employed for relay tubes V_2 and V_3 . Care should be taken that carrier B is not made large enough to trip the OA4-G. It is quite essential that the latter be operated only by carrier C.

Some operators object to using remote control because of the difficulties usually involved in shifting the transmitter frequency from the remote position. The carrier-operated relay unit can readily be adapted to remote frequency control by the simple expedient of adding a third 2051 relay tube, which we shall call V₄. This tube must, of course, be provided with a suitable grid-bias differential. That is, its bias must be somewhat larger than that applied to the grid of

If frequency control in small steps is deemed satisfactory, a number of crystals can be switched in and out, in the proper frequency sequence, by means of a simple multi-point stepping relay connected in the anode circuit of V₄. The circuit would be similar to that employed for V₃. In a system of this type, all r.f. stages except the crystal oscillator should be biased to plate-current cutoff, or nearly so, in order to protect the r.f. tubes while the crystals are being switched.

Continuous frequency control (for example, over a 50 to 100 kc. range in the 14-Mc. [Continued on Page 81]

By RAY L. DAWLEY, WEDHG

A description of a really inexpensive audio oscillator covering the range from 75 to 22,500 cycles and having relatively constant output and unusually good waveform over this frequency range.

For many years past there have been only two general sources of a.f. voltages of good waveform: the beat-frequency audio oscillator and the resistance-stabilized audio oscillator, the latter either with or without plug-in coils and condensers for different frequency ranges. The use of audio-frequency degenerative feedback, which has done so much for the communications industry in recent years, has allowed the design of the entirely new type audio oscillator described in this article. The design of this oscillator depends not purely upon the principle of degenerative feedback but rather upon the principle of obtaining a sharply selective circuit by the action of degenerative feedback upon a broadly selective circuit. Common circuits employing inductance and capacity, as is well known, show a sharply resonant peak at a frequency determined by the reactances of the inductance and capacity making up the circuit. It is not so generally known among radio amateurs that it is possible also to make up a selective circuit by the use only of resistance and capacitance. However, these resonant circuits made up only of resistance and capacity have not, until recently, been of great importance because of the very broad nature of their response characteristic.

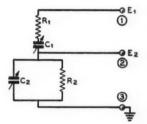
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The Wien Bridge

A simple resistance-capacity network which shows this characteristic of a rather broad resonance peak at some audio frequency is shown in figure 1. It is a simplified version of the so-called Wien bridge which balances out to a frequency determined by the resis-

Figure 1. The resistance - capacity network used in the audio oscillator as the frequency determining element.



tance and capacity making up its branches. As can be seen from figure 2, the resonance characteristic of the circuit is extremely broad, although it does have a general shape which is very similar to that of the conventional tank circuit. It will be noticed also that the phase angle of the voltage E_2 varies with respect to E_1 as the frequency varies from the "resonant" value, leading on one side of resonance and lagging on the other.

A careful look at the circuit of figure 1 will show the reason for the peak in output

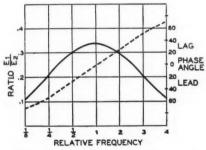


Figure 2. Relative frequency response and phase relations of the network shown in figure 1.

^{*} Technical Editor, RADIO.

voltage as the input voltage is varied. The upper section can be thought of as a high-pass series element whose transmission would fall off gradually as the frequency is decreased. Then, the lower sections across which the voltage is developed can be thought of as a low-pass shunt element which would offer increasing impedance (and hence would allow a larger voltage to be developed across it) as the frequency is decreased.

As the frequency of the voltage across the complete circuit is decreased from a high value the impedance of the lower section would tend to increase until the increasing value of the series impedance of the upper section approached the point where its series impedance was increasing more rapidly than the shunt impedance of the bottom section was increasing. At the point where the two impedances are increasing at the same rate there will be a flat top on the response curve since the total voltage across the two sections is con-

stant and since the two impedances are in-

creasing at the same proportional rate.

As this point is passed, the reactance of C₂ becomes small with respect to R₂ so that the resistance makes up the major portion of the circuit. But, in the upper element the two are in series so that the reactance of the condenser continues to add to the resistance R₁. Hence, the voltage across the lower branch of the circuit falls off as the frequency is decreased past the "resonant" point—or the point at which the reactances of the upper and lower sections are increasing at the same rate.

Frequency of Resonance

Referring back to figure 1, the point at which the voltage at E₂ will be the greatest percentage of E₁, and will have the same phase as E₁, will occur at the frequency determined by:

$F_0 = 1/2\pi \sqrt{R_1R_2C_1C_2}$.

But if the special case is taken where R_1 is the same as R_2 and C_1 is the same as C_2 , the equation for the determination of the frequency greatly simplifies to:

$$F_o = \frac{1}{2\pi R_1 C_1}$$

A careful look at this equation will show a peculiar thing—the frequency of "resonance" is inversely proportional to capacitance, instead of being inversely proportional to the square root of capacitance as is the case with ordinary tuned circuits. This fact is character-

istic of resistance-capacity circuits and allows a much wider frequency range to be covered with a given condenser ratio in this circuit as compared to an LC circuit.

The Circuit

Although the particular circuit of the unit described is new, the general circuit was first shown some time back¹ and an application in a manufactured audio oscillator was shown a year or so later². The self-adjusting feedback control arrangement and certain material on the resistance-capacitance tuning arrangement was taken from an article by Terman and his associates which appeared in the *Proceedings* of the I.R.E.²

The complete circuit of the audio oscillator is shown in figure 3 and consists of six separate functions: the frequency determining network, a two-stage audio amplifier, a regeneration circuit, a variable degeneration circuit, an output control, and a power supply. Each of these sections will be described in detail.

The Frequency Determining Circuit

The frequency of oscillation of the unit is determined by the four-gang b.c. condenser C_{1A} - C_{1B} , the fixed-minimum condensers C_2 and C_3 , and the set of ten resistors R_1 through R_{10} which are switched into the circuit in equal pairs by S_1 . The capacitances and resistances in the two branches of the circuit are made the same so that the simpler equation given under Frequency of Resonance can be used to determine the frequency of oscillation from the known values of resistance and capacitance.

The highest frequency range, 4500 to 22,500 cycles is obtained with the two 40,000-ohm resistors R₃ and R₁₀ in the circuit. The portion of this range above 12,500 cycles will probably not be of any particular use but since the oscillator did go on up above 20 kc. on the switch position which covers the useful range from 4500 to 12,500 cycles, these very high audio frequencies are available in case they should be needed for any purpose. As a matter of fact, it has been stated that oscillators of this type have been constructed to give useful output at frequencies above 2 megacycles.

¹ H. H. Scott, "A New Type of Selective Circuit and Some Applications," *Proceedings I.R.E.*, February, 1938, p. 226.

² H. H. Scott, "A Low-Distortion Oscillator," General Radio Experimenter, April, 1939, p. 1.

³ Terman, Buss, Hewlett, and Cahill, "Some Applications of Negative Feedback with Particular Reference to Laboratory Equipment," *Proceedings I.R.E.*, October, 1939, p. 649.

The other ranges of the instrument are: 2000 to 9000 cycles with the 100,000-ohm resistors in the circuit, 450 to 2000 cycles with the two 500,000-ohm resistors, 220 to 900 cycles with the two one-megohm resistors, and 75 to 220 cycles with the two 5-megohm resistors.

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It will be noticed that the range of the instrument becomes a smaller and smaller ratio as the frequency is decreased. This is because of the increased flattening off of the lower end of the characteristic for each band position as the efficacy of the by-passing and de-coupling within the circuit becomes less at the lower frequencies. The lowest frequency range goes only to 75 cycles and no reasonable changes in the constants of the RC circuit will make it go much lower than this frequency. This latter frequency of 75 cycles was deemed low enough for normal amateur and testing work, but if it is desired to alter the oscillator to allow it to go to a lower frequency, it will be found necessary to increase the values of

coupling condensers, by-pass condensers, and filter condensers a rather sizeable amount. In addition, it will be necessary to replace the output transformer T₁ by a resistor of about 5000 ohms, or by an output transformer with an extremely high primary inductance.

-6-watt

tungsten lamp

120-volt

S-2-pole 6-position

switch (only 5 po-

The Audio Amplifier

Two two-stage audio amplifier of the oscillator is more or less conventional, using a pair of cascaded 6V6GT's, except for the use of a 6-watt Mazda lamp as the cathode resistor and variable feedback resistance in the first amplifier stage. Note that the screen of the first 6V6 amplifier stage is by-passed to the cathode of this tube rather than to ground. This is done to make the tube operate in its proper manner as a beam tetrode.

Regeneration and Degeneration Circuits

The energy for both the regeneration and degeneration circuits is taken from the plate

of the output stage and coupled through the blocking condenser C₅. Here it is divided, the energy for regeneration being fed to the top of the frequency determining circuit and the degenerative energy being fed through the fixed resistor R₁₁ and impressed across the automatically variable cathode resistance R. It is the function of having both a regeneration and a degeneration circuit to hold the overall gain of the oscillator to the level which will just allow oscillation. In other words the oscillation amplitude is kept small enough so that tubes are operating class A without grid current so that the output waveform will be a pure sine wave.

The Variable Degeneration Circuit

It is the function of R, the 6-watt Mazda lamp, in the cathode circuit of the first amplifier stage to act as a variable resistance in series with $R_{\rm H}$ and thus to determine the amount of degenerative voltage fed back into the grid circuit of the first tube. The resistance of this lamp (which has a tungsten filament and hence a positive voltage/resistance characteristic) varies from about 200 ohms when cold to about 2200 ohms with the full voltage drop of 110 volts across it.

The resistor values on the first 6V6GT stage have been proportioned so that an increase in oscillation amplitude will increase the cathode current of the tube. Since the lamp, with its variable resistance characteristic with changes in current, increases its resistance with an increase in current, the increased resistance accompanying an increased oscillation amplitude will increase the feedback voltage. The increased degenerative

feedback voltage accompanying the increased resistance will tend to *reduce* the oscillation amplitude back to the original low value.

Thus by properly proportioning all the resistor values and voltages in the first amplifier stage, the lamp will be operated at a current value which will allow it to show a large increase in resistance with a comparatively small change in current. Under these conditions of operation the amplitude of oscillation of the unit will be kept quite constant. Then, by utilizing the proper value of fixed series degeneration resistor at R₁₁ the amplitude of oscillation may be kept at a value within the class A operating range of the amplifier tubes. The output is thus kept relatively constant over a wide range of frequency, and relatively free of harmonics.

Output Control and Power Supply

The plate of the output tube is fed into one half the primary of a conventional pushpull plates to speaker transformer, the audio output of the oscillator being taken from the highest impedance positions on the voice-coil secondary. By thus using a comparatively high step-down ratio in the output transformer, operating the oscillator into the normal impedances from 200 ohms on up will have almost neglible effect on the operation of the oscillator itself. A 1000-ohm potentiometer across the secondary of the transformer allows a variation in output voltage from a few millivolts to about 5 volts to be obtained.

The power supply is more or less conventional and uses one section of filter with a choke and one section with a resistance. It



Bottom view of the oscillator. The ten range determining resistors are mounted upon the switch which is directly above the two side-by-side tubular condensers.

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na It supplies approximately 200 volts to the plates of the tubes.

Construction and Operation

The unit is built upon a standard chassis and panel and is placed into a standard cabinet. Note carefully that the rotor and frame of the tuning condenser are above ground potential and connected directly to the grid of the first amplifier stage. Consequently it was found necessary to isolate the power supply components physically from this condenser, to saw the rotor shaft short and use an insulated bakelite coupling to a metal dial, and to insulate the frame of the condenser from the chassis by small ceramic pillar insulators.

Aside from these precautions, and the one that the unit must be operated in its shielding box when in the vicinity of a high-power transmitter, the construction of the unit is quite conventional. It should be mentioned, however, that the exact components shown (especially resistor values) be used in the construction of the unit. The values shown are the result of considerable experimentation and variations greater than the normal tolerances of good-grade components are likely to disturb the balance between regenerative and degenerative feedback.

Testing the Oscillator

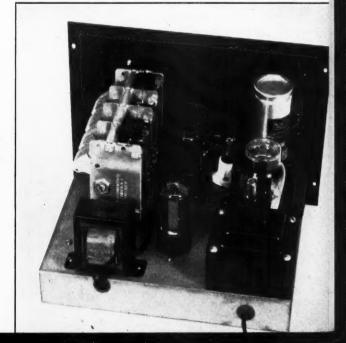
It is best to have a cathode-ray oscilloscope to test the operation of the oscillator on the various frequency ranges, although a good pair of headphones can be used. The most satisfactory test is to use both the phones and the oscilloscope across the output.

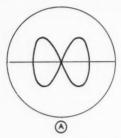
Set the tuning condenser approximately to the center of its range, turn the output control wide open, set the range switch to the third or center position, and turn on the power switch. Listen in the phones and at the same time watch the 6-watt Mazda lamp in the cathode of the first 6V6GT. The lamp should come up to about one-third brilliancy and then should drop back somewhat as the oscillator starts to generate approximately a 1000-cycle tone.

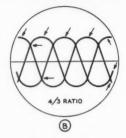
Take a careful look at the waveform on the oscilloscope to see if it is a pure sine wave. If the tubes are normal, the resistors are not too far off, and the unit has been constructed and wired carefully the waveform should be so perfect that it is impossible to detect any irregularities due to harmonic content. It must not be thought that it is improbable that the oscillator will start off properly at the outset since the unit shown and the experimental model just preceding it operated immediately in a satisfactory manner.

Then check the waveform and output over the whole condenser dial and on all switch positions. The waveform should be perfect from about 100 cycles out to the upper frequency limit of the unit. The frequency of oscillation will go out of audibility somewhere between half and minimum capacity on the highest frequency range although the output will still be as strong and as free of harmonics as viewed on the oscilloscope up

Rear view of the audio oscillator. The 6-watt Maxda lamp can be seen between the filter condenser and the rectifier can.







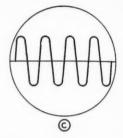


Figure 4. General oscilloscope patterns used in the calibration of the audio oscillator with the aid of a cathode-ray oscilloscope. (A) Pattern obtained with 60 cycles on horizontal sweep and 120 cycles on vertical (or 50 on horizontal and 100 on vertical). (B) Lissajou's figure showing relation of 4/3 between frequency of vertical deflection and of horizontal saw-tooth sweep. (C) Lissajou's figure showing relation of 4/1 between vertical deflection and horizontal saw-tooth sweep frequencies.

to the upper frequency limit of the oscillator. The highest frequency that can be heard will depend upon the reproducer (phones or speaker), the person's ears, and how tightly the laminations in the particular output transformer used are clamped. Most usual phones and inexpensive speakers will go out of audibility somewhere between 5000 and 12,000 cycles but the output transformer of the unit shown could be heard up to about 14,000 cycles.

If the oscillations are too intense and the waveform is distorted, it will be necessary to decrease the resistance of R₁₁. This will increase the amount of degenerative feedback and reduce the oscillation amplitude. Conversely, if the amplitude is too low or if the unit quits oscillating at some point on some range, the value of the degeneration resistor

 R_{11} should be *increased*. If the values shown in the wiring diagram have been followed carefully the unit should operate properly immediately but if it does not it should only be necessary to make a slight change in the value of R_{11} to correct the difficulty.

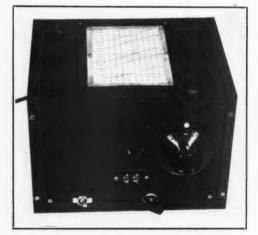
The amplitude will be found to be quite constant over all frequency ranges except the lowest frequency ones; here the amplitude of oscillation may vary over a range of 2 or 2½ to 1. Also, the waveform will commence to be imperfect at the lower end of the lowest frequency range—below 100 cycles. However, if it is desired for some reason to have perfect waveform at the extreme low frequencies, the alterations discussed at the first of the article can be incorporated into the unit.

Calibration

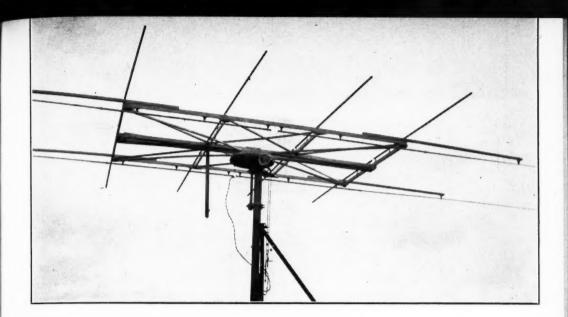
As always, the calibration of a variable-frequency audio oscillator is somewhat of a problem. Naturally, the most satisfactory and least difficult method would be to check the unit by the zero-beat method against another audio oscillator which was already accurately calibrated. Such a piece of equipment will necessarily be available only to a few so that the method described below (which, incidentally, was used to calibrate the one shown) will most likely be used.

Calibrating with an Oscilloscope

If an oscilloscope having a sweep oscillator going from about 10 to 5000 cycles is available (the one shown on page 518 of the 1940 RADIO HANDBOOK was used in our case), the calibration becomes a simple matter of about one-half hour's watching of interesting waveforms. It may sound slightly involved or complicated in the description but it is really [Continued on Page 74]



The audio oscillator shown mounted in its cabinet with the calibration chart on the top.



Practical Two-Band Rotary Beam

By FRED D. ROWE, * W6FK, and MAX P. FISHER**

A detailed article on the construction of a combined 10- and 20-meter rotary array with an exact list of the materials required and giving an easily understood step-by-step construction technique.

For the amateur with no opportunity to erect a telephone pole to support a beam; who instead has to work on a tar-paper and gravel roof in a restricted space; who, being a city dweller, is forced to conserve on weight, physical dimensions, and conspicuousness, the rotary beam antenna described herein will fit both his purpose and his pocketbook.

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The beam consists of a four-element 10-meter beam in combination with a two-element 20-meter beam. Inasmuch as the type and the exact length of the elements are a matter of choice, as well as the method of feeding them, no specific preference is expressed. Tenth-wave spacing between the elements on both hands was used; however, by scaling up the sizes given later, any desired spacing may be used. This article will devote itself to helping the amateur with the constructional difficulties which confront him, and leaves the electrical problems to be solved by any of the recognized methods.

The rotary beam described below is handoperated or motor-driven. Weight of the

wooden framework for supporting the elements, including the standoff insulators, the head for rotating, and the iron brackets for fastening the whole unit to the mast is approximately 40 pounds. Screws and bolts are used throughout and the lumber can be obtained at even the smallest lumberyard. No machining or precision fitting is required, and anyone of even moderate ability should have no difficulty in making the beam in his garage, basement or spare room. For the amateur with a workshop at his disposal, the parts will literally fly together. The very large number of the brethren who have been putting off having a rotary beam to improve their signal reports from all points of the compass have mostly been held back on account of two factors: first, cost; and, second, limited facilities for a homebrew job. By following the cook book description of the beam's construction as outlined here, Mr. Average City Dweller will be enabled to put out signals on his new rotary beam two-band antenna in very short order.

The first consideration is how big should the frame for supporting the elements be? Using tenth-wave spacing on the two bands,

^{* 136} Cole St., San Francisco, Calif.

^{** 745} Eleventh Ave., San Francisco, Calif.

Detailed construction drawing of the framework and the rotating arrangement.

it was found to require a frame approximately 10½ feet long by 6½ feet wide.

Supporting Framework

To take the fabrication of the supporting wooden frame for the elements in progressive steps, the start is made by laying the two pieces of 2" x 2" (FW1) parallel, with a 4-inch space between. Then, using the scrap from the 2 x 2's, cut 4 blocks, 4 inches long, to go in between the 2 x 2's, and bolt (FM4) into place. This frame should be perfectly square. Now mount standoff insulators (FS1 & 2) on the cross pieces (FW3), and then lay cross pieces in position on top of the 2 x 2 frame. Adjust these to the desired spacing required between the elements by sliding on top of the 2 x 2 frame. When you have the cross pieces lined up for both spacing and squareness, mark the points of contact with the 2 x 2 frame. (If necessary, the 10-meter elements may be temporarily put on the insulators.) Remove

the elements, if same were placed on the stand-offs, and then screw the cross pieces to the 2 x 2 frame (FM6). The next step is to fasten the ends of the cross pieces together by butting the end pieces (FW2) to the ends of the cross pieces, and then use 5-inch triangles cut out of either 3/8-inch presdwood, or 1/2-inch plywood (FW6) to fasten these together by screwing the triangles onto the bottom of the cross and end pieces. Now, using the small angle irons (FM1), bolt (FM2) the same joints together at the top, but on the inside of the frame. Next, using the extra piece of stock (FW3), cut to correct size and screw (FM5) these pieces onto the top of the 2 x 2 frame as diagonal cross braces. These should extend from the end cross piece to where the second cross piece meets the 2 x 2 frame. Now, right in the center of the 2 x 2 frame screw (FM5) the two pieces (FW5) on the frame, one on the top side and the other on the bottom. This completes the frame.

Bracing the Frame Internally

Looking at the bracing when completed, it looks complicated, but in reality it is very simple. Begin the bracing by screwing (FM5) the four 10-foot pieces of bracing stock (FB1) to the bottom of the 2 x 2 frame where the center piece or cradle ends (FW5). This operation should be done with the frame upside down; i.e., the standoffs on the cross pieces should be pointing down towards the floor or ground. The next step depends upon the movability of these braces (which we will now call the long diagonal braces), so do not anchor or fasten these to the corners of the frame as yet. Looking at the frame, and the four braces just put on, you will see four points where the two center cross pieces and the long diagonal braces cross. Here a space of some three inches exists between them. These spaces are now put to use by springing the long diagonal braces down against the two center cross braces and screwing together. If the strain seems to be excessive, modify by inserting a 3/4 inch piece of wood between and then screw together.

When this is completed, the long diagonal braces will be found to be pushing down against the four corner triangles, on the frame. Now drill holes for the bolts to fasten the ends of these long diagonal braces to the triangles at the four corners of the frame. Slip the bolts in place and fasten. Turn the frame right side up. We are now ready to put on the second set of braces or the short diagonals (FB2). These are screwed on top of the 2 x 2 frame at points where the two center cross pieces fasten onto the 2 x 2 frame. The opposite ends are placed on top of the corner triangles, and the same bolt

that holds the long diagonal braces on the bottom of this triangle slips through the end of the short diagonal. Now, we are ready for the last braces or "X" braces (FB3). These are put on by fastening their outer ends to the triangles on the inside of the two center rectangular spaces formed by the two center cross pieces and the end pieces bounded on the inside by the 2 x 2 frame. Cross the two pieces to form an "X" on each side of the 2 x 2 frame, and then screw onto the top of the 2 x 2 frame at points where the two center cross pieces and the frame touch.

This completes the frame and the bracing; and here is a good point to get out the old paint brush and weatherproof the frame. Enamel is good. As soon as the paint or enamel is dry, the 10-meter elements are ready to mount on the cross pieces, and the beam is complete for the 10-meter elements. This brings us to the 20-meter elements.

Mounting the 20-Meter Elements

The 20-meter elements are mounted by simply screwing standoffs underneath the frame at desired spacings on the end pieces (FW2). This provides approximately 10½ feet of support for the approximate 34-foot span of these elements. If ¾ inch or smaller diameter tubing is used, an outrigger on each of the four ends extending another six feet will add the much desired rigidity to the 20-meter elements. In the case of the author's beam, tubing of 15/16 inch diameter was used, and the outriggers designed to eliminate all droop at the ends of the elements as well as to take out the play between the elements. It was also found that with this device stand-

Frame on roof, ready to proceed with the mounting. Mast and rotary head in the foreground ready to take the frame.



PARTS MATERIALS AND

FRAME (F) Wood (FW)

2.	two pieces	2" x 2" 11/4" x 34" 11/4" x 34"	11 feet long
4.	four pieces two pieces	1/g" x 1/g"	8 feet long 2 feet long

Frame Braces (FB)

1.	four	pieces pieces pieces	34"	x	3/4"		 		 			 					 	 	 		 	 * 1	 	10	feet	t I	on	g
2.	four	pieces	3/4"	X	3/4"		 	 	 	۰		 					 		 	٠	 	 	 - +	6	feet	1 1	on	g
3.	tour	pieces	3/4	×	3/4		 		 			 	 		 	 	 	 	 		 	 	 	. 4	ree	6 1	on	q .

Metal (FM)

1.	twelve	11/2" galvanized iron angles
2.	fifty	21/2" x 1/8" round head galv. iron bolts, with nuts and washers
3.	eight	3" x 1/8" round head galv. iron bolts, with nuts and washers
4.	four	81/2" x 1/4" round head carriage bolts, with nuts and washers
5.	sixty-two	heavy shank, flat headed 13g" brass screws
6.	eight	heavy shank, flat headed 21/2" brass screws

Standoffs (FS)

1.	forty	11/2" standoff insulators with 11/4" brass bolts and lead washers
2.	eighty	1" narrow shank round head brass screws with fibre washers

ROTATING HEAD AND DRIVE (RH)

Wood (RHW)

1.	two pieces	11/2"	×	10"	 2 feet long
2.	one piece	11/2"	X	10"	 2 feet long

Metal (RHM)

1.	one	11/4" diameter round shaft, 2 feet long
2.	one	7" diameter round gear (have welded to end of shaft)
3.	four	3's" bolts with nuts and washers, 9 inches long
4.	four	1/2" bolts with nuts and washers, 6 inches long
5.	two	5716" bolts with nuts and washers, 2 inches long
6.		flat ball thrust bearing
	one	
7.	two	cast iron pillow blocks with 11/4" hole
8.	one piece	iron 5/16" thick, 2" wide, with two 9/16" holes drilled
9.	one piece	iron 5/16" thick, 2" wide, bent to form clothesline pulley support with two 9/16" holes drilled
10.	two	5" dia, die cast clothesline pulleys
11.		cable for driving any required length, and any small pulleys for dodging corners, if necessary
12.	one	pulley 11/2" dia. and 7" long, fastened firmly to 1/2" shaft
13.	one	1/2" diameter shaft, any required length
14.	two	small pillow blocks, with 1/2" hole
15.	one	crank handle for turning beam
		MAST ANCHORAGE (MA)

(MAW)

1.	one piece	4"	X	4"	*****	15 feet le	ona
2.	one piece	2"	×	4"		5 feet le	ong
3.	three pieces	2"	X	2"		10 feet l	onq

Metal (MAM)

1.	six	2" lag screws with washers
2.	four	3" lag screws with washers
3.	two	3/8" bolts with nuts and washers (9" long)
4.		one quart of paint or enamel

ard stock lengths of tubing could be used, and the splices were within well-supported areas. The outriggers were made of 1½ x 1½ inch wood stock, mounted on top of the end pieces of the frame, and extending out six feet with a 14-inch overlap on the frame to which they were bolted (FM3). Also by adjusting the distance out from the frame to where the standoff is mounted, on the bottom of the outrigger, the elements can even be raised slightly above level, if so desired. With the outrigger painted and in position, the 20-meter elements can be mounted on the bottom of the frame and the two-band beam is complete and ready for erection.

Getting the Frame Topside

If not convenient to raise the frame to the roof in one piece, it may be taken apart and hauled up in small bundles on ropes. Either method should be done with the elements off the frame to prevent breaking of the standoffs. The suggestion is made of placing the frame on the roof, if the roof is flat, and letting it stand in the weather for a day or two until the rotating mechanism is completed. If this is done, any bolts or metal parts will show signs of rust and can be painted before the final raising of the beam on the mast.

Rotating Mechanism

The simple and time-tried method of "cable and pulley" rotation was found to be the most economical and positive, especially where one is working with just a few tools and a limited pocketbook. The four essentials of this system are: a bearing for the beam to rotate on, a method of turning the frame, a positive lock in any position, and heavy duty type of construction. The bearings for the frame are made by using a secondhand flat ball thrust bearing to take the downward weight, and two standard "pillow blocks" for the side support. The top pillow block also carries the downward thrust of the thrust bearing.

The connection between the frame and the rotating shaft is made by having a plate, or, in the author's case, an old gear wheel 7 inches in diameter and ½ inch thick, welded to one end of the rotating shaft. Four holes are drilled in the plate or old gear to take the four ¾-inch bolts (RHM3) which bolt the frame, master pulley and the plate together. When the shaft (RHM1) has the gear or plate on one end, slide on the opposite end the flat thrust bearing and then the two pillow blocks (RHM6). As a precaution against the beam ever lifting the shaft upward out of the bearings, a small ¾-inch pin was

put through the shaft, just below the bottom pillow block.

To rotate the beam, a large pulley was made out of three pieces of wood (RHW1 & 2) by cutting the two pieces (RHW1) 21 inches long, and cleating them together with a third piece (RHW2). This was then taken to a local carpentry shop and sawed round to form a round pulley 20 inches in diameter. Thus the master pulley is completed. Next make the two pulleys to feed the cable on and off the master pulley by fixing two 2 inch diameter clothesline pulleys on an iron bracket which mounts on the mast. The bracket (RHM9) was made using a piece of iron 5/16-inch thick and 2 inches wide. This was bent to the desired shape so that it formed a yoke across the back of the mast to retain the bolts which clamp the top pillow block to the 4 x 4 inch mast. The drive cable (RHM11) is then wrapped one and

[Continued on Page 93]



W6FK makes final inspection. Note detail of the retary head and the method of mounting it on the mast.

De Luxe, High Output

112 MC. TRANSCEIVER

By W. W. SMITH, * W6BCX

Besides delivering 7 watts of carrier, this transceiver possesses none of the usual disadvantages of the typical transceiver now in common use. Improved performance is realized at only a slight increase in the total cost of the installation.

Widespread interest shown by old timers and newcomers alike in the small, battery-powered 112-Mc. transceiver described in the March issue of Radio indicated that an article on a transceiver suitable for permanent installation in an automobile would be in order. Subsequently several circuits were tried, and after the results with various circuits and tubes were compared, there evolved the unit shown in the accompanying illustration. In

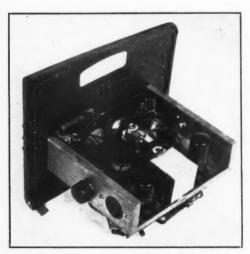
many respects this unit is somewhat unorthodox

Most of the 112-Mc. mobile transceivers now in use incorporate either a 6J5GT, 7A4, 6P5GT, or HY615 as the oscillator. With these tubes the output is limited to about 3 watts maximum. In fact, most transceivers using such tubes deliver about 11/2 or 2 watts to the antenna. That more output is not realized is due to the fact that when the oscillator is loaded so as to deliver maximum output on transmit, it will not superregenerate on receive. Loosening the antenna coupling so as to restore superregeneration on receive results in lower output on transmit. If an attempt is made to raise the output by increasing the plate voltage, the tube gets excessively hot and either "runs away" (the plate current creeping until the tube finally goes out of oscillation) or else does not "come on" for several seconds when first turned on receive after several minutes of transmission. If more than 200 volts is used on the plate, a moderately high value of grid leak must be used in order to keep the tube from becoming too warm on transmit. Then there is trouble with the oscillator trying to superregenerate on transmit, which requires that the feedback be reduced by means of a small condenser from grid to ground, or by using a very small value of grid condenser. Thus we see that while these tubes may work well for reception, they are not especially well suited for use as a transceiver oscillator where more than about 2 watts is wanted in the antenna.

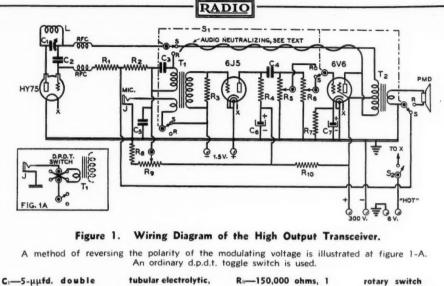
The ORO Oscillator

The transceiver illustrated uses one of the new HY-75 triodes. These tubes cost con-

* Editor, RADIO



Final version of the transceiver, after being torn down and rebuilt about four times and being subjected to a dozen alterations. The result is a job that delivers from 6 to 8 watts output and is a pleasure to operate.



spaced midget condenser (with mounting bracket and ceramic shaft coupling) C2-100-µµfd. smallest mica condenser Cs-.01-µfd. tubular condenser, 400 v. C--.05-µfd, tubular condenser, 400 v. Co-0.25-µfd. tubular condenser, 400 v. Co-8-ufd. midget

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450 v. C:-10-ufd. 25 - v. electrolytic R1-2500 ohms, 5 watts R2-1 meg., 1 watt R3-100,000 ohms, 1/2 watt R4-100,000 ohms, 1 watt Rs, Re-100,000-ohm potentiometer, a.f. gain taper R:-500 ohms, 5 watts

Rs—150,000 ohms, 1 watt

Rs—50,000 ohms, 1 linear (voltage divider) taper

Rso—7500 ohms, 1 watt

RFC—Midget u.h.f. chokes

J—Open circuit jack (a closed circuit jack viill chart the

J—Open circuit jack
(a closed circuit
jack will short the
microphone battery)
S1—4-pole 2-throw

rotary switch
52—S.p.s.t. toggle
switch

T₁—Transceiver transformer: plate and s.b. mike to single grid

T2—Universal output transformer: 1 4, -000 ohm c.t. pri., adjustable v o i c e coil winding

PMD—Small p.m. dynamic speaker L—See text

siderably more than a 7A4 or 6J5, but are ideally suited for oscillator use in a transceiver. They have a μ of 10, which is about optimum for use as an ultra-audion oscillator, as no provision need be made to reduce the r.f. feedback to prevent superregeneration when transmitting. They are not microphonic, and are husky enough that a respectable amount of input may be run with the tube just loafing. The only possible disadvantage to the use of an HY-75 is its greater filament power (2.75 amps.), and greater cost.

Built around an HY-75 oscillator, the transceiver illustrated works so much better than the average transceiver that the slightly greater cost is more than justified. Some of the

advantages are as follows:

1) Will still superregenerate on receive when the antenna coupling is adjusted for maximum output on transmit (approximately 7 watts output when fed from a 300-volt vibrapack).

2) Has more than sufficient gain to drive a p.m. dynamic speaker to full volume.

3) Does not exhibit "backlash" in the regeneration control (point at which the set goes into superregeneration on receive).

4) Is not objectionably microphonic. Can be used with the car in motion—both transmit and receive—if a rigid antenna is used.

5) Gain controls both for microphone and receiver, each operating independently.

High modulation capability in a positive (upward) direction.

7) No "hash" in microphone circuit as is common when mike voltage is taken from the auto battery. No need for frequent replacement of microphone battery.

8) Several components (such as mike battery and speaker output transformer) do double duty, thus minimizing number of components.

9) No tendency towards motorboating or instability when both microphone and receiver gain are run "wide open."

10) Not critical in adjustment; requires no juggling or fussing with values for proper functioning.

Modulator Coupling Innovation

An unusual feature is the use of the speaker output transformer as a modulation transformer. This not only eliminates the need for a modulation choke, because a speaker transformer is required anyhow, but permits a phase reversal of the modulating voltage applied to the oscillator. This is desirable because a single-ended beam tetrode operated slightly over-biased to cut down plate current will deliver nearly twice the rated a.f. output for a given plate voltage if about 20 per cent 2d harmonic distortion can be tolerated. This degree of distortion would not be permissible on music, but does not noticeably affect the intelligibility of speech. The important thing is to apply the modulation to the oscillator phased so that the "flattening" by the modulator lops off the negative peaks. With ordinary Heising modulation in which a choke (not center tapped) is used, this result is not obtained; the positive peaks are flattened off first. By using a center-tapped choke, not only is the core saturation reduced (thus permitting the use of a smaller choke), but the polarity of the a.f. output of the single-ended modulator is reversed before being applied to the oscillator, the phase then being that desired. The output transformer To simply acts as a center-tapped choke on transmit, the voice coil winding being opened.

This transformer may be most any outputto-dynamic-speaker transformer designed for push-pull pentodes, or may be one of the new adjustable ratio output transformers. The impedance match to the voice coil is not critical, and it may off as much as 2/1 with no effect except a slight reduction in maximum available volume from the speaker.

The primary winding should be rated to stand about 40 ma. or more. The actual current drawn will be about 50 ma. on one side and 30 ma. on the other when transmitting (assuming a 300-volt plate supply). As the unit will seldom be used on transmit for long periods of time, a slight overload on one half the winding will not cause the transformer to heat excessively. A midget, adjustable voice coil winding transformer rated at 36 ma. has given no trouble in the unit illustrated.

The sheet that comes with the transformer cannot be used to determine directly the correct voice coil tap, even if the voice coil impedance is known. It can be calculated from the sheet as follows, however. Multiply the voice coil impedance (usually 4 or 6 ohms for a small p.m. dynamic) by 2, and taking this new value as the impedance of the voice coil, refer to the chart to see what taps reflect a 14,000-ohm plate-to-plate (entire pri-

mary) load for this value of voice coil (8 or 12 ohms).

It is just about as quick to determine the proper tap by ear, trying different taps until maximum volume is obtained. The matching of the voice coil has no effect whatsoever on the matching of the 6V6 as a modulator, as this is automatically taken care of by the center-tapped primary.

Avoiding A.F. Feedback

Most transceivers that incorporate a stage of a.f. ahead of the modulator or power output tube have a tendency toward a.f. feedback (motorboating or howling) when the gain is advanced very far. This is a result of running leads from both the input of the speech stage and the output of the power stage to one set of contacts on the send-receive switch. Shielding these leads does little good, because it is impossible to shield the switch contacts from each other so long as they are on the same switch. This small amount of capacity coupling between the switch contacts is sufficient to cause a.f. feedback when much gain is used.

A simple way to cure this feedback when a split choke or transformer is used for coupling the modulator is by means of capacity neutralizing as shown in the schematic diagram. A piece of hookup wire is soldered to the opposite end of the transformer primary and twisted around the lead running from T₂ to S₁. At the switch, the end of the free wire is adjusted with respect to the wire from T₁ (thus varying the capacity between them) until is possible to run the gain "wide open" both on transmit and receive without a.f. feedback. Occasionally the motorboating or squeal may be cured simply by reversing the leads either to the secondary or high impedance primary of T₁, thus making the feedback degenerative instead of regenerative. However, this does not always work, in which case the twisted "neutralizing lead" will be required.

The dual volume controls may appear to some as an unnecessary refinement, but practice has shown the desirability of being able to adjust both the receiver gain and the microphone gain *independently*.

Voice Polarizing Switch

In figure 1-A is shown a simple means of incorporating a d.p.d.t. toggle switch to reverse the microphone polarity. This optional refinement is included for those who are concerned with voice waveform asymmetry. With most male voices, slightly heavier modulation

[Continued on Page 82]

A CRYSTAL CONTROLLED V.F.O.

The recent introduction of wider-range variable crystals has made a direct crystal-controlled v.f.o. unit capable of covering a wide frequency range an economical possibility. These new crystals are 80-meter units having a fundamental frequency variation of approximately 12 kc. with ranges of two, four and eight times this amount when their frequency is multiplied into the 40-, 20- and 10-meter

bands, respectively.

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Since these new crystals have the relatively high temperature coefficient of 50 cycles/°C./Mc. it is imperative that the crystal oscillator stage be designed to have an absolute minimum of crystal current. The use of one of the wide-range crystals in a relatively high-power crystal stage such as is commonly used with low-drift crystals will almost certainly result in a great deal of frequency drift. As the crystals require a low-power oscillator, and since their wider range makes them suitable for crystal-controlled v.f.o. use, their logical application is in an operating-desk exciter feeding the transmitter through a link.

The Circuit

The diagram of the crystal-controlled v.f.o. is given in figure 1. From this diagram it may be seen that a "hot cathode" type of oscillator is used, the screen acting as the anode for the oscillating portion of the tube. Electron-stream coupling to the plate of the 1852 provides either fundamental or harmonic output in the plate tank L1-C1 which covers the 80- and 40meter bands. The circuit constants are so proportioned that the excitation to the crystal is the minimum required for reliable operation, thus keeping the crystal current to a minimum. The use of an 1852 as the oscillator tube is another feature which helps to stabilize the oscillator, since this type of tube has such high transconductance that a very minimum of excitation is required for full output.

Two crystal sockets on the sloping panel allow the use of two variable crystals for covering a wider range of frequencies. Alternatively a single variable crystal may be used in one of the sockets and a fixed crystal in the other. The latter crystal may have a fundamental frequency in the 160,-80- or 40-meter bands. With either 80- or 160-meter crystals, the output circuit may be tuned to 80 or 40 meters. When a 40-meter crystal is used the output frequency is limited to 40 meters since the output tank circuit covers only the 80- and 40-meter bands.

Switching

The v.f. crystal oscillator is provided with two sets of terminals at the rear of the cabinet for keying the relay-control purposes. Keying is accomplished directly in the cathode of the 1852. The terminals for the relay allow the transmitter to be controlled by switch S2, which is on the panel of the exciter. This switch is a double-pole single-throw type which shorts the keying contacts and closes the transmitter relay circuit when it is thrown to the "on" position. The crystal switch, S1, may also be used to control the transmitter by switching it to the center open position. This requires that the stages following the exciter be biased so that their plate current does not rise unduly when excitation is removed.

Output Indicator

A novel feature of the v.f. crystal oscillator is the use of a 6U5 tuning "eye" tube as a direct output indicator in place of the usual meter. The triode section of the 6U5 is coupled to the output tank through a small coil and the rectified r.f. is made to open the eye. Tuning the output tank to resonance in-



This small cabinet houses the oscillator and its power supply. The large knob at the center of the panel tunes the output circuit to either 80 or 40 meters. Crystals are plugged into the panel, where they are available for quick change or frequency shift.

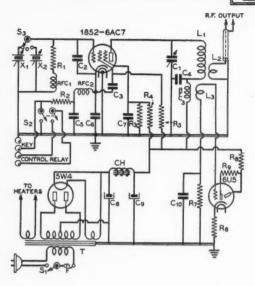


Figure 1. Diagram of the V.F. Crystal Exciter.

C ₁ —140-μμfd. mid- get variable	Watt
C2000015-µfd.	- Rs-200,000 ohms, 1
mica C ₃ —.01-μfd. 400-	R_9 —1 megohm, $\frac{1}{2}$
volt tubular	RFC ₁ , RFC ₂ , RFC ₃ —
C₁01-µfd. mica	21/2 mh. r.f. choke
C:-0.1-µfd. 400-	SS.p.s.t. toggle
volt tubular	switch
C₀	S:-D.p.s.t, toggle
C7-01-µfd. 400-	switch
volt tubular	S:-Three-position
Cs, Cs-4-µfd. 450-	tap switch
volt electrolytic	L1-30 turns no. 22
C10-0.1-µfd. 400-	d.c.c. closewound
volt tubular	on 1" dia. form
R ₁ -20,000 ohms, 1/2	L2-3 turns no. 22
watt	d.c.c. at cold end
R2-150 ohms, 1 watt	of L
R ₃ -20,000 ohms, 1	L3-3 turns no. 22
watt	d.c.c. below L2
R ₁ 100,000 ohms, 1	T-500 v. c.t., 50
watt	ma.; 5 v., 2 a.; 6.3
Rs30,000 ohms, 2	v., 1 a.
watts	CH-10 hy., 50 ma.
Re-10,000 ohms, 1	F-2-amp, fuse
watt	X ₁ , X ₂ — Variable or
R:-100,000 ohms, 1	fixed crystals

volves merely tuning for greatest opening of the shadow on the tube target.

The self-contained power supply is of the simple brute-force filtered type employing a single choke and two $4-\mu fd$, electrolytic condensers. The transformer may be of the midget broadcast variety.

Transmitter Coupling

The output available at the transmitter end of the link is slightly under 3 watts on both

80 and 40 meters with 80-meter crystals. This same amount of output is also obtainable on 40 meters when crystals having a fundamental frequency in that band are used. The 80-meter output when using 160-meter crystals is again around 3 watts, but the 40-meter output from a 160-meter crystal will be somewhat reduced. When using a 160-meter crystal care must be taken to be sure that the output circuit is not tuned to the third instead of the second or fourth harmonic of the crystal.

The 3 watts of output from the exciter is sufficient to excite practically any present crystal stage in the transmitter, and in many cases will be found to be great enough so that the v.f. exciter can replace the present crystal stage. Normally the transmitter's present crystal stage will be operated as a doubler with link coupling from the exciter. The socket formerly used to hold the crystal can then well be used to mount a tube-base type coil acting as a grid tank. The grid tank may be made quite low C and consequently have a broad resonance characteristic to allow a large amount of frequency shift without retuning.

Radioddities

The 160-meter band is the only one which is an odd number of kilocycles wide.

U. S. hams occupy a total of 18,485 kc. of radio spectrum. Approximately one-third of this territory is taken by the 1½-meter band alone.

Phone operation is permitted in over threequarters of the total ham spectrum.

Switching from the lowest to the highest amateur frequency represents a frequency change of over 230 to 1.

Radio shield "experts" will be interested to know that at the other ends of the tremendous band of vibrational phenomena, shield materials take odd forms. Lead is used against radium rays, while glass will shield the ultra violet.

If human eyes responded to radio waves and ordinary light did not exist, eyeglasses would be made of paraffin.

Lately it has been the practice of the F. C. C. not to assign three-letter broadcast calls "except in cases where 'good will' has attached to the use of such existing call letters."

2000 and 4000 kc. are the only top-edge ham frequencies whose harmonics also mark the lower edges of higher-frequency bands.

An All-Purpose

PORTABLE TRANSMITTER

By J. E. STRIKER, * W6MOV-W6OPG

A description of an all-band portable transmitter with self-contained modulator and power supply and having provision for genemotor operation when at a distance from an a.c. line.

After building a number of portable transmitters and having them sit on the shelf until a field day came along or the big rig failed during a QSO, the thought came to mind that for just a few cents more a portable could be constructed so that it would be adaptable as an exciter unit for both audio and r.f. The average r.f. power output of a portable is comparable to that of the average buffer stage. By the same token the audio power output of the portable's modulator is about the same as the conventional class A driver stage in a larger transmitter. In order to conserve space, but still meet all of the necessary requirements, including d.c. adaptability, the transmitter shown here was decided upon.

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With cost in mind, it was decided to use 6L6's for the final r.f. stage and also the modulator. Inexpensive tuning condensers are used in the exciter section and a single-button microphone is used instead of the usual crystal. However, an extra octal socket was installed so that if at some future time it was decided to use a crystal microphone it would be a simple matter to wire up a high gain

speech amplifier (see figure 1A).

The power transformer chosen delivers 400 volts d.c. under load. The uncased type chokes for both filter and modulator were chosen due to their compactness. A 6A6 oscillator was decided upon as a suitable exciter, with the second triode as a frequency multiplier. Ample excitation is supplied to the 6L6 (4 ma. under load) with only 150 volts on the 6A6. The 6L6 operates straight through and is neutralized. The only time it is necessary to double in the 6L6 is for 5-meter operation. A 40meter crystal is used for both 5 and 10 meters, as the second triode of the 6A6 quadruples quite nicely from 40 meters to 10.

For a.c. operation S₆ connects the heaters to the filament transformer and for d.c. the same switch is placed in the other position connecting the heaters to the Amphenol socket in the rear of the chassis. The input side of the filter choke is also connected to another prong in the same socket so that a single cable from an external d.c. supply need merely be inserted. Unfiltered d.c. may be applied to the choke; external filter will be unnecessary since CH1 and C15 offer ample filtering action.

In order to use the r.f. section for a crystal and buffer, and at the same time use the audio section as a speech and driver, S7 is placed in the c.w. position. The voltage applied to the 6L6 final amplifier is now unmodulated d.c. The plate of the 6L6 modulator is brought out to another Amphenol socket into which a cable may be inserted, coupling the 6L6 to a class B audio amplifier. With the proper choice of tubes it is an easy matter to run 400 watts input to an external final amplifier with

all of the necessary drive from the portable. The main transmitter at W6MOV uses a pair of 35-T's in the final, modulated with another pair. Ample drive was obtained from the portable's audio section to drive the class B stage to full output and at the same time to furnish enough r.f. excitation to the final amplifier to operate at 350 watts input. In coupling to the primary of the 35-T driver transformer a 1.0-µfd. condenser was used as shown in figure 3.

Tuning Up

It is advisable to tune up the transmitter on 10 meters first. Insert the 40-meter oscillator coil, 40-meter crystal, 10-meter multiplier coil and 10-meter final coil. Be sure that S₁ is in the multiply position. Adjust oscillator tuning condenser C₈ for maximum output as indicated by maximum grid current to the multi-

^{* 1655} Everett Ave., San Jose, Calif.

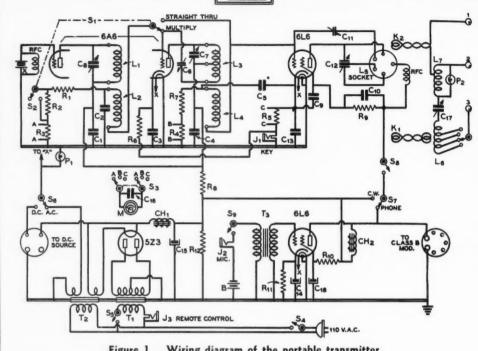


Figure 1. Wiring diagram of the portable transmitter.

, C₂, C₃, C₄, C₅— .01-μfd. oil-i m p . metal-case vibrator condensers C₆-3-30-μμfd. mica trimmer

C7-50-µµfd. midget variable Cs-100-µufd. mid-

get variable

C .-. midget mica

C10-.006-µfd. midget mica

C .. Twisted hookup wire or 3-30 μμfd. mica trimmer with

screw removed C12-100-μμfd. per

section split stator C15-.005-µfd. 1000-

volt mica

C11-10-µfd. 50-volt electrolytic

C15-8-µfd. 500-600 volt paper or oil

C16-002-µfd. m i d get mica C17-200-µµfd. mid-

get variable C1N-2-µfd. 450-volt

electrolytic

R₁-15,000 ohms, 1 watt

R₂-25,000 ohms, 1

watt R3, R4--75 ohms.

watt R:--25 ohms.

watts R=-500 ohms.

watts R:-15,000 ohms, 1

watt

R-10,000 ohms, 20

watts R .- 15,000 ohms, 10 watts

Ru-50,000 ohms, 20 watts

R11-600 ohms, 10 watts

R₁₂-50,00 ohms, 25 watts

S1, S2-Mult.-straight

through switch S:--Meter switch

S .- A.c. line switch

S.—Plate power switch

S .- A.c.-d.c, filament switch

S:--Phone-c.w.switch S.—Amplifier plate switch

S.-Mike battery switch

RFC-2.5-mh. 125-

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ma, r.f. choke J:—Closed circuit keying jack

-Open circuit mike jack Is-Closed circuit re-

mote jack T,-1000 v. c.t., 250

ma.

T₂-6.3 v. 3 a., 5 v. 3 a.

T3 - Single-button mike transformer CH₁, CH₂-8-hy. 150-

ma. choke Coils-See coil table

P:-Pilot lamp, 6.3 v. P2-6.3 v. ant. tuning lamp

M-0-100 d.c. milliammeter

plier section (second triode of 6A6). If, after removing the plate voltage, the oscillator does not start readily, move the rotor slightly toward the low capacity side. With the regeneration condenser C6 about 50 per cent engaged adjust the multiplier section tuning condenser C₁ to resonance. This will be indicated by maximum grid current to the 6L6. Gradually increase the capacity of C6 until an optimum position is reached. This will be

when the maximum output from the multiplier section is obtained without self-oscillation being present. After each adjustment is made on C6 it will be necessary to readjust C7 and Cs slightly. After these three condensers are adjusted remove the crystal to see if there is any self-oscillation in the multiplier section and if so reduce the capacity of C_6 just below the point of self-oscillation. After these adjustments are properly made there should be

COIL DATA

STAGE	WINDING	160	80	40	20	10	5
Oscillator L ₁	No. of turns Size of wire Spacing of turns Space btw, L ₁ and L ₂	50 26 none .25"	29 22 none .3"	16 18 none .4"			
Multiplier Grid L ₂	No. of turns Wire size Spacing of turns	65 28 none	35 26 none	18 24 none			
Multiplier Plate La	No. of turns Tap from top of coil Wire size		33 18 18	24 13 18	13 7 18	8 4 20	
	Spacing of turns		none	none	wire	diam.	
	Space btw. L ₃ and L ₄		.3"	.25"	.25"	.1"	
Amplifier Grid	No. of turns Wire size		32 26	17 24	14 20	8 20	
L	Spacing of turns		none	none	wire	diam.	
Amplifier Plate	No. of turns Wire size	45 20	32 20	18 18	14 18	10	3 10
Ls	Spacing of turns	none	none	wire	diam.	air wound se	f-supportin

All oscillator coils are wound on Bud Senior forms. Multiplier coils are wound on Bud Junior forms except the 10-meter multiplier which is wound on a Hammarlund CF-5-M type. This is an isolantite form and will be of a lower loss than bakelite. Amplifier plate coils are wound on Bud Senior forms except the 10- and 5-meter coils which are air wound and self-supporting. A piece of lucite makes an excellent base for homemade low-loss coils. Just salvage a 5-prong tube and use the prongs from it.

about 5 ma. flowing in the grid circuit of the 6L6.

At this time it would be a good thing to check the frequency of the multiplier to be sure that you are actually quadrupling from 40 to 10 meters and not picking up some other harmonic. C₇ should be about 40 per cent engaged when tuning to the middle of the 10meter band. It will be found that even though regeneration is used in this circuit there is no evidence whatsoever of frequency instability. The regeneration control need never be adjusted again after this initial setting. For reasons unknown to the writer an RCA 6A6 seemed to be the only tube of this type that would function properly on 10 meters. Neu-tralize the 6L6 in the conventional manner and everything is in readiness for 10-meter operation. For 5 meters merely double to 5 by replacing the 10-meter final coil with the 5-meter coil.

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S₁ and S₂ are ganged together, the reason being that the total resistance of R₁ and R₂ is the grid bias for the second triode when S₁ is in the multiply position. When S₁ is in the straight through position this total resistance then becomes the grid resistor for the 6L6. The resistor bias requirement for the second triode of the 6A6 is greater than that of the 6L6 so a portion of this resistance is shorted out with S₂ when S₁ is in the straight through position. This portion is 25,000 ohms, R₂.

Meter Switching

When S₁ is in the *multiply* position, position no. 1 on S₃ reads grid current to the second triode of the 6A6. Position no. 2 reads grid current to the 6L6 and position no. 3 reads plate current to the 6L6. When S₁ is in the *straight through* position there will be no reading in the no. 2 position. The no. 1 position

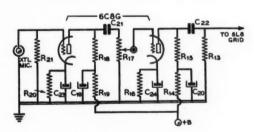


Figure 1A. Circuit of optional twostage speech amplifier to feed 6L6 modulator from a crystal microphone.

C ₁₉ , C ₂₀ —Dual 4-µfd. 450-volt electroly-	R ₁₆ —1500 ohms, ½ watt
tic C ₂₁ , C ₂₂ — .01 - μfd. 600-volt tubular C ₂₃ , C ₂₄ —Dual 10-μfd. 50-volt electrolytic R ₁₃ —750,000 ohms,-1 watt	R ₁₇ — 750,000- o h m potentiometer R ₁₈ —500,000 ohms, 1 watt
	R ₁₈ —10,000 ohms, 1 watt
R ₁₄ —10,000 ohms, 1 watt	R ₂₀ —1,500 ohms, ½ watt
R ₁₅ —500,000 ohms,	R ₂₁ —2 megohms, ½

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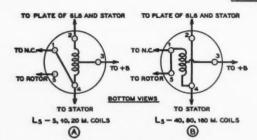


Figure 2. (A) Prong 1 is strapped to prong 4 connecting the neutralizing condenser to the opposite end of the coil from that connected to the plate. The coil itself is wound between prongs 3 and 4 thereby placing the tuning condenser in the split-stator position. The effective tuning capacity will range from 3 μμfd. to about 50 μμfd. (B) Prong I is strapped to prong 5 connecting the neutralizing condenser to the opposite end of the coil from that connected to the plate. The coil is wound between prongs 4 and 5, and prongs 2 and 4 are strapped. This arrangement places the tuning condenser in the parallel position with a maximum capacity of 200 μμfd, and a minimum of 12 μμfd.

will now read grid current to the 6L6 with no. 3 reading the plate current.

When operating straight through on the fundamental frequency, the second triode (multiplier section) is not in use. All tuning adjustments are made in the conventional manner. When operating on twice or four times the crystal frequency the procedure to follow is the same as that outlined for 10 meters except that it will not be necessary to

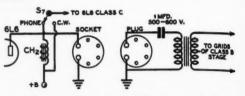


Figure 3. Method of connection for using the audio section of the transmitter as a speech and driver unit for a medium powered class B stage.

make any adjustments on the regeneration control C₆. On frequencies lower than 28 Mc it is quite possible to obtain too much excitation to the 6L6. In that event detune the oscillator or frequency multiplier condensers slightly until the proper amount of grid current flows, about 4 ma. The dissipation of the 6A6 will not be exceeded in doing this due to the low plate voltage applied to the tube.

If a crystal microphone is desired it is well to remember that adequate shielding is necessary. A small shield can should be mounted around the microphone jack and a 2-megohm grid resistor, R₂₁, placed inside the shield can. Shielded wire should be used to the grid cap on the top of the 6C8G tube as well as all other long leads, such as those leading to the gain control, etc. Also use a shield between the speech and the r.f. sections. Sometimes it will be necessary to place r.f. chokes in the first and even sometimes the second grid of the 6C8G. It is also well to shield the gain control.



Figure 4. Front view of the all-purpose portable transmitter. The white reference dots behind the control knobs were made by spotting a shallow hole with a small twist drill and then filling the hole with heavy white paint.

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Figure 5. Rear view of the unit showing coil placement and the location of the baffle shield between the oscillator and amplifier stages

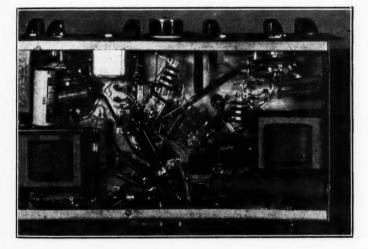


Figure 6. Under-chassis view of the portable transmitter.

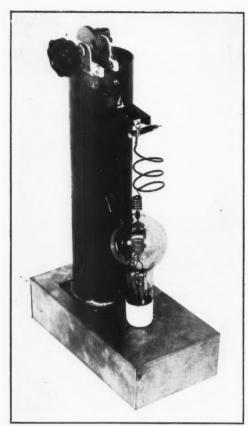
Illustrations

Figure 4 shows the front view with all of the tuning controls. The white dots above the bar knobs were made by drilling small holes about 1/32" deep and filling them with thick white paint. The lettering was done with a rubber stamp set. A set of rubber stamps may be purchased at the five and dime store for 10 cents. The pilot light on the right is the antenna tuning and modulation indicator and the one on the left the filament pilot.

Figure 5 is the rear of the transmitter. The filament transformer is on the left with the antenna condenser and coil directly in back of it. Just to the right of the antenna coil is the final tank coil, with the final tank condenser and 6L6 adjacent. To the right of the shield

can be seen the multiplier coil form and its tuning condenser directly behind it. To the right of this is the oscillator coil form. The oscillator tuning condenser cannot be seen behind this coil. Between these two coils and slightly forward is the 6A6 and directly in front of that the filter condenser. The power transformer is on the right, and in back of it may be seen the 6L6 modulator and the 6C8G speech amplifier (6C8G in shield can). The 5Z3 rectifier is on the extreme right and hides the gain control. The 6L6 final amplifier switch, S₈ is just to the right of the filament transformer. Along the rear of the chassis, in the vertical edge, are from left to right, the a.c.-d.c. toggle switch S₆, a.c. socket,

[Continued on Page 92]



This concentric-line oscillator with a 75T gives good stability and a quite reasonable power output on the 2½-meter band.

A 100-WATT RESONANT LINE 112-MC. OSCILLATOR WITH A 75T

The accompanying photograph and diagram illustrate a concentric line controlled 112-Mc. oscillator using a 75T, which will put out approximately 100 watts of stabilized r.f. on any frequency in the 112-116 Mc. amateur band. A short concentric line, which is resonated to the operating frequency by means of a 35- $\mu\mu$ fd. midget variable, acts as the frequency determining element, while the output power is taken from a self-resonant coil in the plate circuit.

The concentric line itself is 12 inches long and 27/8 inches inside diameter (3" o.d. with 1/16" wall), and the inner conductor is 131/4 inches long and 3/4 inches in diameter. Both pieces which make up the line are cut from standard lengths of thin-wall copper water pipe. To make up the line first the inner conductor is soldered to the center of a piece of 20-gauge copper sheet about 31/2 inches square with the aid of a small alcohol torch

TWO U. H. F.

and a soldering iron. Then the outer conductor is slipped over it and also soldered in place. Considerable heat is required to do the soldering, but if the work is placed on a block of wood as insulation, a small alcohol torch and a conventional electric soldering iron will do the job quite easily. The wood will be thoroughly charred when the work is finished but it will have served its purpose. Asbestos would probably be better but wood will be satisfactory.

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A hole is drilled in both the inner and the outer conductor 2½ inches up from the base on the line. Then another hole is drilled in the center of the base so that a wire may be run through it, through the inner conductor, and then through the hole 2½ inches up through both the inner and outer conductor to connect to the grid of the tube. This wire is by-passed immediately to ground and one side of the filament of the 75T as it leaves the base of the line.

The plate coil consists of three turns of no. 12 wire 11/4 inches in diameter and 2 inches long. The upper end of this coil is by-passed to the concentric line by means of a .0001-µfd.

Semi-schematic of the 75T 112-Mc. oscillator.

C1—35-μμfd. midget variable

C2—.0001-μfd. 5000-volt mica

C3—.003-μfd. midget mica

C4—.0005-μfd. 1000-volt mica

R1—5000 ohms, 10 watts

L1—Concentric grid line—see text

L2—Resonant plate coil and link—see

OSCILLATORS

5000-volt mica condenser. This plate coil was found to resonate over the entire 2½-meter band with the plate-to-ground capacity of the 75T and the distributed capacity of the circuit.

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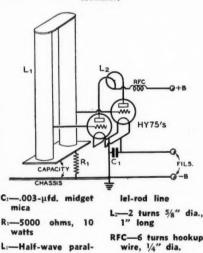
-μfd.

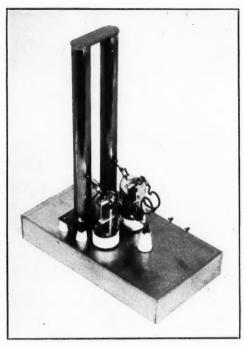
With the circuit constants shown the grid condenser will tune the oscillator to the center of the 2½-meter band when it is about half meshed. About 30° rotation of the condenser will cover the band. Approximately 100 watts output may be obtained from the oscillator at 1250 plate volts and at a plate efficiency of 50 to 65 per cent.

A 20-WATT PARALLEL-ROD 224-MC. OSCILLATOR WITH HY75'S

The unusual push-pull parallel-rod oscillator shown alongside has proven to be quite a satisfactory source of power for experiments in the 11/4-meter amateur band. A parallel-rod

Semi-schematic of the 20 to 25 watt 224-Mc. oscillator.





A 224-Mc. oscillator of good power output using the new HY75's.

line is used as the frequency controlling element and a small self-tuned coil is used in the plate circuit. The resonant line is made up of two $\frac{7}{8}$ inch, thin-wall copper pipes spaced $\frac{7}{8}$ inch, $9\frac{1}{2}$ inches long overall, and connected together both at the top and bottom to act as a half-wave line instead of the more common quarter-wave arrangement. The base for the line is a piece of 20-gauge sheet copper $1\frac{3}{4}$ " by 4" which is mounted above the $9\frac{1}{2}$ " by 5" by $1\frac{1}{2}$ " chassis by means of one-half inch standoff insulators.

The capacity to chassis of the copper base plate acts as a by-pass for the center of the parallel-rod line. The copper plate can be proven to be acting normally as a by-pass since its center will be quite cold to r.f. One of the standoffs which supports the copper plate is of the feedthrough type and has the grid leak connected between its lower end and the grounded side of the filaments of the

tubes.

The power output of the oscillator as shown is 20 to 25 watts with 450 volts on the plates of the tubes. The plate efficiency is approximately 40 per cent with the half-wave line in the grid circuit as shown. The plate efficiency was somewhat less than this until the original quarter-wave grid line was replaced with the capacity-shortened (grid-to-ground capacity) half-wave line.

A Compact

28-MC MOBILE TRANSMITTER

By WILLIAM J. DRIML, * W6NAT

During two years of experimenting on low power portable mobile units the writer wished for a small, compact transmitter which could be placed in any convenient corner of any part of the car, even including the glove compartment. Finally, the little "High Power Midget" was developed. In every way results are equal to those obtained with previous,

more bulky models.

The total drain from the battery is only 9 amperes, including that of a 300-volt 100ma. vibrapack and all heaters. The 7F7 tube is a single-ended duo-triode of loktal construction, designed especially for use as a phase inverter or as a voltage amplifier. The plate and grid of each triode section are brought out separately, thus permitting adaptations to special circuit requirements. The 7F7 tube is the nearest loktal counterpart of a 6N7. This was put to work as a crystal oscillator and doubler.

The 7C5 tube is a beam power amplifier which provides high power output with low heater drain. The electrical characteristics and applications are similar to those of the type 6V6.

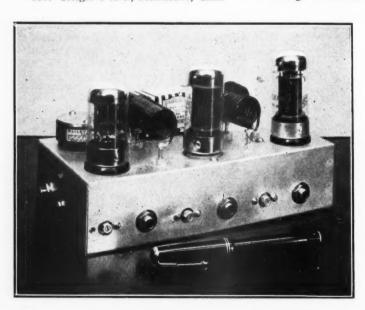
Construction

The transmitter is built upon a standard manufactured chassis measuring 4" x 8" x 2". All tuning condensers and meter jacks are placed in front of the chassis, making very convenient tuning and metering of the transmitter. Because of the unusually compact construction, it will be found best to mount and wire the components in the order to be

The oscillator-doubler tube is mounted one inch from the end of chassis. The type sockets that were chosen can be held in place by means of a mounting ring, and take up but little space when so installed.

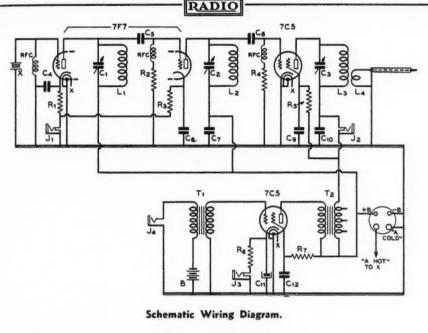
The crystal coil, wound on 3/4" bakelite tubing, is mounted under the chassis with

* 1817 Colegrove Ave., Montebello, Calif.



This compact 28-Mc. mobile transmitter will fit in the glove compartment of most cars. It uses the new loktal tubes.





tra midget variables
C₃— 25-μμfd. ultra
midget
C₄—.001-μfd. midget
mica
C₅—.00025-μfd. midget mica
C₆, C₇—.001 - μ f d.
midget mica
C₈—.0001-μfd. midget mica

Co, C10-.001 - µ fd.

C1, C2-50-µµfd. ul-

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midget mica
C₁₁—10-µfd. 25 v. electrolytic
C₁₂—0.25-µfd. paper tubular
R₁—1000 ohms, ½ watt
R₂—75,000 ohms, ½ watt
R₃—1500 ohms, ½ watt
R₄—75,000 ohms, ½

R₅—10,000 ohms, 1 watt
R₆—450 ohms, 5 watts
R₇—10,000 ohms, 1 watt
RFC—2.5 mh. midget r.f. choke
J₁, J₂, J₃—Closed circuit midget jacks
(J₂ must be insulated from chassis)
J₄—Open circuit midget jack

T:—Midget microphone transformer
T:—Midget modulation transformer,
1-1 or preferably
slight step-up ratio.
Connect so d.c. in
windings buck,
thus reducing core
saturation,
B—3-volt microphone
battery

X-7-Mc. crystal

spade bolts, and screwed down to the side of the chassis in back of the oscillator tuning condenser. By soldering the cathode resistors and the by-pass condensers first, it is possible to avoid the difficulty that will be experienced if an attempt is made to solder them in after the oscillator tuning condenser is mounted.

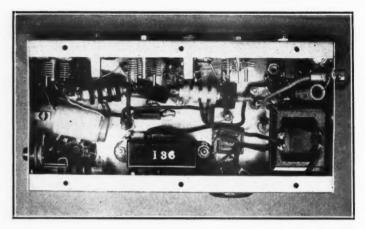
Right in back of the oscillator tube is the socket for the crystal; directly underneath this socket is the microphone input jack. The final amplifier socket is next with bypass condensers placed as illustrated. The modulator socket and associated parts then are wired, with the meter jack put in place and soldered to the cathode resistor of the modulator tube. The last things to mount and wire are the microphone input transformer and modulation transformer. All of these units are comfortably placed under the chas-

sis, with ample working room if directions are followed carefully.

The doubler coil is wound with no. 14 enamel wire and mounted on polystyrene through-panel insulators and soldered firmly in place. The final tank coil is mounted exactly as the doubler coil, with throughpanel insulators. The antenna link coil then is mounted on the cold end of the final coil, one side grounded to chassis and the other going through a panel insulator to an auto antenna connector on the side of the chassis.

The microphone battery is a small "airplane" 3-volt type and is mounted on top of the chassis directly in back of the final amplifier tube. A larger, external battery will give somewhat better battery economy.

One lead is grounded to chassis and the other lead runs through a rubber grommet connected to the microphone jack. The mi-



While it looks as though the parts and wiring were "poured in," no difficulty will be experienced if the components are mounted and wired in the recommended order.

crophone can be any good single-button type.

A four-prong socket mounted on the back of the chassis serves for the heaters and power supply connections.

Operation

When the transmitter is ready for operation, place a 0-50 milliameter in the crystal circuit and adjust condenser C₁ until the meter jumps up to about 20 ma. Now tune the doubler condenser C₂ for resonance dip on the meter.

COIL DATA

L₁—37 turns no. 22 d.c.c, on ³/₄ inch bakelite tube.

L2-18 turns no. 14 enam., 1 inch dia., spacewound.

L3-8 turns no. 14 enam., 1 inch dia., spacewound. Place the meter in the final amplifier circuit and tune to dip. It should read about 15 ma. When the final amplifier is tuned out of resonance the meter should read about 40 ma. when no antenna is connected.

Next connect the antenna to the link and adjust the final coupling until there is only a very slight dip in plate current as the plate tank is tuned through resonance. (A quarter-wave antenna is recommended. Any good fish pole antenna will be satisfactory.)

Now check the modulator tube to see that it draws about 25 ma. Retune the crystal oscillator condenser until the plate current reads about 30 ma. If less current is read the oscillator may not come back into oscillation every time.

The complete transmitter unit can be purchased at a price every amateur can afford for portable work. The total cost including tubes is only \$12.00 (less the Vibrapack.)

The transmitter has worked many dx stations with good reports. Contacts with Hawaii have been R-7-8, "very good quality and heavy modulation."

Five Meters Opened to F.M.

In a press release dated April 13, 1940, the FCC announced opening part of the 56-to-60 Mc. amateur band to frequency modulated radiotelephone transmission. To quote the official release:

"The Federal Communications Commission today modified the rules governing amateur radio operators and stations to make available to amateurs the band 58,500 to 60,000 kilocycles for radiotelephone frequency modulation transmission.

"Previously amateurs were permitted to use radiotelephone frequency modulation in all amateur bands above 112,000 kilocycles. The change in the rules will make possible wider experimentation in this type of transmission, since equipment is quite generally available for the lower band.

"The Commission also took the opportunity to re-arrange, in the interest of clarity, the other rules which specify the use to be made of the amateur bands, although no changes were made therein."

A RURAL ROTARY ROTATOR

By C. O. BISHOP. *W7HEA

We had seen pictures and been told over the air of many gadgets that could be used to "rotate the rotary," but when the time came for us to provide some means of spinning the old beam around, none of these devices could be found in this part of the state of Washington. Investigation did reveal though that a number of old cream separators were on hand in the local hardware stores and could be obtained very reasonably, as most of them were sold as junk. The parts that wear out and render them useless as separators are not required for beam swinging; so we beat the junk man to the draw and hauled one of them home. It turned out to be just what the doctor had ordered and the picture shows the final result.

All unnecessary parts were removed and the remainder taken to the machine shop for the conversion. The motor mount was installed so that the motor connects directly to the former high speed shaft with a short piece of hose and two clamps. The main shaft was turned down to take a standard "V" pulley with half-inch hole, which is the power takeoff. The original handle was on a stub shaft and this was removed. The stub shaft just slips nicely over a three-quarter-inch water pipe, and so was remodeled to be used on the base of the pipe mast as the pulley shaft. The shaft was then turned to take a "V" pulley with a half-inch hole. On the end of this shaft a small section or stub was cut down to one-quarter inch for the purpose of attaching the indicator switch.

The motor is an old washing machine motor which can be reversed by means of a switch from the operating position. Be sure to get a motor that has a wound field instead of the winding on the armature; otherwise it will be impossible to reverse it remotely. The terminal strip on top of the motor shows how the leads were brought out. From there four wires go to the reversing switch at the operating position. With the standard 1750 r.p.m. motor, the power take-off pulley turns just twelve revolutions per minute. With the added reduction of the two "V" pulleys and

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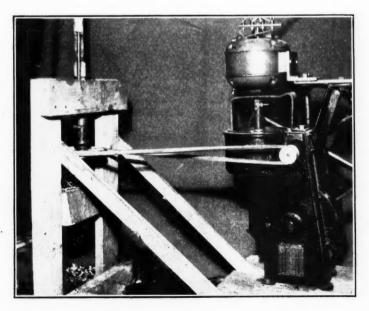
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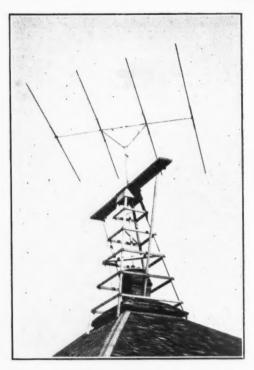
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A view of the rotator installation. The revamped cream separator is at the right with the reversible washing machine motor mounted, shaft vertical, on top of it. The V-belt runs from the power take-off on the vamped separator to a pulley on the turneddown stub shaft which is mounted on the end of the vertical pipe support for the rotary. The direction indicator coupled to the stub shaft below the pulley and mounted on the crooked piece of wood below the pulley.



^{*} Box 82, Zillah, Washington



The four-element rotary itself, installed through the dummy chimney in the house.

belt, the beam speed is three r.p.m. This has been found to be very satisfactory.

Original trials of the arrangement showed that the beam had a lot more drift than could be tolerated; so an additional pulley was installed in the bowl just under the connecting hose. A short piece of belt is bolted to each side of the bowl and allowed to drag very gently at all times. Very little drag is needed to stop the drift. The bolt shown sticking up alongside the mast is used as a stop to keep the beam from going around too many times in the same direction and ripping off the feeders. A bolt was placed through the pipe, and when this hits the stop the belt slips and no damage is done. The indicator switch is mounted on the cockeyed piece of lumber just below the end of the pipe mast. It consists of an eight-point switch made from an old volume control. This is connected by means of a nine-wire cable to the indicator with its eight pilot lights representing the points of the compass.

This rotator, although rather bulky, was economical to construct and has given very good service ever since its installation. It is mounted in the attic, and as the chimney happens to be a dummy, the pipe mast was brought down through it a la Santa Claus, with the unit mounted directly underneath. Rubber washers under the rotator make it practically silent in the house.

Dotty Dots and Dashes

By THE GUY WITH THE SNOWSHOES

One of my associates who doesn't know a bug from a modulator asked me a nice easy one the other evening. "Say," he said, "why do they have two codes; wasn't the old Morse code good enough for wireless?" I went into a discourse on the inadvisability of spaced characters of the landline Morse from a standpoint of accuracy, how easy it was to read a T for an L and how static might take out one dot from the letter H and make the sign &. He seemed impressed and accepted the answer as final. But I kept on thinking.

The first thing that came to mind was that the only spaced character in the Continental code was the sign &. I started thinking how much we hams owe to the old Morse operators. Of course we owe them the "and" sign (&), a dot, a short space and three dots.

Why hams will write & as "es" I'll never know. It's no more "es" than the Morse R (...) is "ei."

Our semi-automatic key has been called a "bug" since the day of the old "side-swiper" and Mr. Martin's first Vibroplex. Legend has it that the term "bug" was used by Morse operators long before it became the trade-mark of the Vibroplex. The term "fist" to identify the nature of an operator's sending is even older. It took a good fist to work some of those "Rube Goldberg" keys in the old days. But what about our abbreviations, and how did punctuation start?

Originally there was no punctuation and most of the necessary punctuation was developed as necessity demanded. The most in-

[Continued on Page 87]

112-224 Mc. Hints

By E. H. CONKLIN, *W9BNX

With a larger interest in the ultra-high frequencies now than at any earlier time, our readers may welcome some ideas on the construction and operation of u.h.f. power oscillators that will remove the dangerous high voltage from the plate circuit, eliminate the need for filament chokes, improve frequency stability, and help to get good performance.

If the power supply negative is disconnected from chassis and ground, it becomes *very* difficult to get across the high voltage unless the negative is exposed—all arguments to the contrary notwithstanding. Unless grid lines are used without isolating them from the bias circuit, however, very little is accomplished by such an unorthodox suggestion. The d.c. connection to these lines, too, can

be eliminated without difficulty.

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The fundamental push-pull oscillator circuit is shown in figure 1. It is readily seen that a large mass of metal is hooked to both sides of the high voltage. This means that the apparatus should not be approached with the power on, even to adjust shorting bars, because it is impossible to touch anything without a large chance of getting across the high voltage. It is much easier to isolate the negative than it is the positive, by grounding the negative to the chassis only through a high voltage by-pass condenser. There are several ways of taking the power off the grid lines by using grid condensers, and either separate grid leaks or by running insulated d.c. bias leads inside of the grid pipes. These methods are shown in figure 2. It will be seen that the need to insulate the line from the chassis is completely eliminated in either case. Drilling holes in the grid pipes may be bothersome, in which case the bias leads can

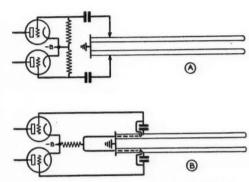


Figure 2. Alternative methods of obtaining d.c. grid bias when using grounded grid lines.

be run close to and alongside of the pipes rather than within them, with the same effect.

A similar stunt is easily applied to the plate line, as shown in figure 3. This arrangement allows the plate pipes to be bent down to the chassis and secured there, making possible a vertical coupling hairpin that can be mounted conveniently on the chassis rather than way up in the air. A sliding shorting bar is unnecessary when the lines are deliberately made short and are loaded slightly with a two-plate condenser which, incidentally, facilitates adjustment. The r.f. path between the lines, in any event, should be copper or copper plated metal. Silver is better, aluminum nearly as good, but brass is out.

A line that approximately resonates with the tubes' output capacity can be adjusted considerably by altering the pipe spacing—rather than by moving a shorting bar—because a given capacity has a greater loading effect on a more widely spaced line. A disadvantage of wide spacing, of course, is radiation of power within the room. How much this



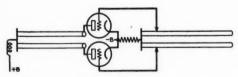


Figure 1. Fundamental push-pull oscillator circuit.

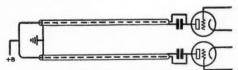


Figure 3. Method of removing plate voltage from plate pipes and eliminating the necessity of insulating them from the chassis.

radiation can be, is readily illustrated by the ease of coupling out the power by means of a "hairpin" coupled only to the shorting bar.

A transmission line circuit, in which tube elements are hooked on the "hot" end of the line, or otherwise load the resonant circuit with the equivalent of a low resistance, cannot build up a high impedance with the tube in operation. This suggests that an attempt to use lines closely approaching a quarter wavelength, or made of large diameter pipe, may be uneconomic in many cases. For instance, if the grid line can be made to control the frequency, with the grids tapped far down the line, large plate rods will probably add very little to the efficiency or stability of the oscillator. On the other hand, when the plate line controls the frequency, a grid line may be no better than a coil. Plate tuning becomes much more critical when a grid coil is replaced with a good line, limiting operation to a much smaller range of plate circuit tuning. Some effect on frequency will remain, of course, but careful adjustment will result in a sharper signal, capable of heavier modulation without spreading over a good share of

The taps on the grid lines, the grid and other r.f. leads should be made with thin copper strip or tubing in order to reduce inductance. Some transmitters are controlled by the plate lines until the connections from tubes to the grid line taps are made with

short pieces of copper strip.

As the frequency is raised, the length of a wire in terms of wavelength becomes more appreciable. It may be possible no longer to connect the filament leads of two tubes in such a way that the filaments are at ground potential, and with no impedance between them. This may introduce hum and may make impossible either perfect neutralization or a 100 per cent modulation capability in an amplifier, and may seriously affect the operation of an oscillator.

In general, the larger the tubes and the higher the frequency, the more necessary filament chokes or lines will become. The use of chokes in each filament lead was suggested some time ago. More recently, commercial



Figure 4. Arrangement for using shortened ½-wave line in filament circuit instead of r.f. chokes.

television requirements have led to the development of lines in the filament circuit. electrically a half wavelength long, so that the ground point on the shorting bar is reflected to the center of each filament. The circuit is shown in figure 4. Each cathode is hooked to the end of a pipe. An insulated wire inside of the pipe carries one side of the filament circuit. The other connection is fed either on the pipe or on a second insulated wire inside. The length of the rods will be considerably less than a half wavelength due to the reactance of the filaments and their leads. Wider spacing between the rods will permit them to be shorter, due to the greater loading effect upon higher surge impedance lines. The rods can be folded back for convenience. In one amplifier, RCA uses rods running in different directions along a metal

In some amateur rigs, the three sets of lines (grid, plate, filament) have been reduced to two by grounding the grids and using roughly ½ rather than ½ wavelength lines in the filament. This moves the grid tuned circuit around to the filament but apparently does not remove the resistance loading effect of the tubes' input circuit which is then connected across the whole grid (filament) line. Maximum stability, therefore, may not be obtainable with this method. Furthermore, the same problem of grid lead impedance may lead to the application of the former ½ wavelength filament lines to the grid circuit!

The copper tubing required by a u.h.f. oscillator may deter the isolated amateur from constructing an auxiliary u.h.f. rig. Rain spouting and plumbing tubing may not be available, but often sheet copper can be obtained. Two parallel strips of sheet metal are cheaper than tubing, but are more susceptible to mechanical vibration that might modulate the transmitter. If the edge of the strip is bent to form an L-shaped cross section, the strength will be improved materially.

In adjusting an oscillator for a good note and for stability under conditions of changing plate voltage (modulation), a five- or tenmeter superhet is very useful. It is amazing how vile some rigs sound on a good superhet equipped with a beat oscillator, and how much they drift. Often, they are heavily modultaed with a.c. hum.

Some interesting things about neon bulbs have been noticed that help in adjusting a transmitter. When these bulbs are used on 60 cycle power, they glow orange over a large part of their interior. As the frequency is raised, the light becomes blue with a bright

[Continued on Page 88]

"Pete" Towle, W4DMY, boarding the ship on which he returned from a recent trip to the Bahamas. Left to right: Inglis Howe, VP7NC; Hugh Curry, second op at VP7NU; Pete Towle, W4DMY; Joe Forsythe, VP7NU; and Lloyd Thompson, engineer at ZNS.

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DEPARTMENTS

- DX
- The Amateur Newcomer
- U. H. F.
- What's New in Radio
- Yarn of the Month

RADIO-

"WAZ" HONOR ROLL

CW and PHONE	LU7AZ38116	W8LZK3699	PHONE
Z C	LU7AZ38116 W3DDM38116	G6B.I 36 99	W3LE38128
ON4AU40158	W9UQT38116 W8MTY38114	VE1DR3698 W9VES3698 W8LDR3697	F8UE38103 W6OCH36107
G2ZQ40147	W9KA 38 114	W8LDR3697	W6ITH3699 W3FJU3687
G2ZQ 40 147 J5CC 40 130 W8CRA 39 156 W2BHW 39 156 W8BTI 39 153 W2GTZ 39 153 W2GTZ 39 152 G6WY 39 151 W6GRL 39 151 W6CXW 39 150 W2GT 39 150 W2GT 39 150 W2GT 39 150 W2TJ 39 149	W9ELX38113	W8AAT3696 W9GKS3695	VEICR3687
W2BHW39156	W6VB38113 W8LFE38113	G6YR3694	VE1CR3681 W9NLP3595
W8BTI39154	W8LFE38113 G6CL38112 W8HWE38112 G2QT38112 W8EUY38112 W9CWW38112 W2BXA38111 W6GRX38111 LV1138110	W21ZO3694	W9TIZ3593 KA1ME3579
W2GTZ 39 153	G2OT 38 112	VE5AAD3692 W4ADA3690	F8VC3578
W2HHF39152	W8EUY38112	W1APU3691	F8VC3578 W4CYU34100
G6WY39151	W9CWW38112	WUIRE 36 On	W9ELX3488 W1ADM3493
W6CXW39150	W6GRX38111	W8JAH3689 OK2HX3686	ON4HS3492
W2GT39150	LY1J38110		W6EJC3484 W7RVO 34 80
W9TJ39149 W4CBV 39 144	LY1J 38110 W1AB 38110 W6HZT 38110	VK2NS3684	ON4HS3492 W6EJC3484 W7BVO3480 W4DAA3471
W4CBY39144 W6CUH39143 W6KIP39143	W4MR38108	W6T1 36 80 W7DSZ 36 73 W2GXH 36 71	W2IXY33102 W6NNR3392
W6KIP39143 W8OSL39143	W8KWI38108	W2GXH3671	GM2UU3384
W9KG39143 W9KG39141 W6ADP39140 W6BAX39140	W8BOX38106 W9ADN38106	W2GXH .3671 W1WV .35119 W8OXO .35113 W6GHU .35103 W4QN .35103 W9PGS .35103 W6HJT .35103 K6NYD .35100 W8CLM .35100	F8XT3370
W6ADP39140	W80E38106	W6GHU35103	W3FAM3368 W6MLG3297
	W8GBF38105	W9PGS35103	W8LFE3291
W9TB39134	001000111100	W6HJT35103	W8LFE3291 W2IKV3290 W4DRZ3289
W6QD39134	G210	W8CLM 35100	W9Q13286
W2ZA39134 VK2EO39133	J2KG3895	W8CLM3599 W8OUK3599	W1HKK3285 W8QXT3285
G5BD39133 W2GVZ39132	G6XL3895	W8CJJ3598	G5BY3285
W4CYU39132	W9VDQ3879	OK1AW3596	W/9BEII 32 85
W4CYU39132 W3EVT39131	SU1WM37138	W3RT3595	W4DSV 32 84
W5KC39130 W2GWE39129 W6KRI39129	W6GAL37134	W8OUK .35. 99 W8CJJ .35. 98 W2WC .35. 98 OK1AW .35. 96 W3RT .35. 95 W9EF .35. 94 G6QX .35. 94 W8NV .35. 94 W3DRD .35. 93 W6AQJ .35. 92 VE5ZM .35. 92	VK4JP 32 85 W4DSY 32 84 W6OI 32 83 W9TB 32 82
W6KRI39129	W8KKG37127	W8NV3594	W9TB3282
VE4HU39120	W7AMX37125	W3DRD3593	W91B 32 82 W61KQ 32 80 VE1DR 32 59 W1AKY 31 92 W3EMM 31 88 W8LAC 31 85 G6BW 31 83 G3DO 31 78
W7BB39123 W6HX39123	W1BXC37123		W1AKY3192
G5R 1 30 120	W2IOP37122	LU3DH3589 W9GNU3588	W8LAC 31 85
W2IYO39119 W8JSU39118 W2CYS39117	W6MVK37118	W9ERIJ 35 88	G6BW3183
W2CYS39117	G6NF37115	K6CGK3588	G3DO3178
G2LB39115 W41O39115	W8PQQ37115 W9PCQ 37 114	K6CGK3588 W9VDX3586 W6KQK .3585	W1KJJ 3178 W6FTU 3177 G8MX 3173
W7DL39115	W3TR37113		G8MX3173 W8RL3171
W7DL39115 W3BEN39115	ON4FT37112	ON4NC3582	W8RL3171 W9UYB3171
W2GNQ39113 W6FZL39112	W2BJ 37 134 W6GAL 37 131 W8KKG 37 127 W7AMX 37 125 J2JJ 37 123 W1BXC 37 123 W1BXC 37 122 W1RY 37 120 W6MVK 37 118 G6NF 37 115 W8PQQ 37 115 W8PQQ 37 115 W9RCQ 37 114 W3TR 37 113 ON4FT 37 112 W6MEK 37 112 W6MEK 37 112 W6ADT 37 111 W11ED 37 111	ON4NG3582 GI6TK3580 W4ELQ3580	W9UYB3171 W6AM3167
ON4HS39111	W6ADT37111	W8QIZ3578 W6GK34105	F8KI3158
ON4EE 30 110			W9ZTO .3153 W4EEE .3086 W2GW .3088 W1JCX .3081 W2IUV .3079
W6F7V 30 100	W7AYO37110 VE2EE37108 W4DMB37108 W5ENE37107	W8CED .34 .102 W8CED .34 .102 W8BSF .34 .100 W1APA .34 .98	W2GW3086
W6SN3999	VE2EE37108	W8CED34102	W2IUV3079
W9NRB3998 W6GPB3994	W5ENE37107	W1APA3498	
XE1BT 39 90	W61TH37105 W6NLZ37105	VV/B/B 34 44	W8AAJ3077 W9BCV3068
K6AKP3978 W1CH38 150	W3KT37105	W9VKF3496 VK2AS3494	VV 0 IVI Z D 30 32
W1CH38150 W2GW38143	W3KT37104 W9PTC37103 W3FJU37103		G6DT2983 W4BMR2980
W5VV38144	W9GBJ37103	W3EYY3491 W9MQQ3489	K6NYD2978
W3HZH38139 W3EMM38139	G6GH 37 102		CO2WM2978 W9RBI2971
W8BKP38138	W3AYS37 102 VK2DA37 101 W6FKZ37101	W6TE3488	W6NLS2964
ZL1HY38138 W5BB38136	W6FKZ37101	W6CVW3488	W6GCT2962
W8I FC 39 136	W6.IBO37101	VK20Q3487	W6NRW2960 W2GRG2874
W3EPV 38 136	W8KPB37100 W4DMB37100	W2FLG 34 89 W6TE 34 88 G6WB 34 88 W6CVW 34 88 VK2OQ 34 87 G5VU 34 85 W9BCV 34 83	
W9GDH38134 W3HXP38133 W4FVR38130	W9A.IA3799		W8NV2865 W7EKA2863
W4FVR38130 W9FS38130	W4EQK3799 ON4VU3799	ZS1CN3482 W6PNO3482	VE2EE2862
W9FS38130 W3EAV38130	W3EXB3/98	VK2TF3481 W6MJR3481	W4DRZ2862 W1BLO2862
W8JMP38127	ZL2CI3797 W6DLY3797 W6MHH 37 95	ON4SS3480	VK2AGU2861
W2GRG38127 ON4EY38126		W6HIP3476 VK2TI3475	W3EWN2793
W8ZY38125	W6MCG3792	W7AVL34 75	W2DYR2777 W2HCE2776
W1ADM38125 W3GAU38125	G2UX3791 W2BSR3790	W8JK3475	W2HCE2776 W5CXH2752
W3EVW38124	W9UBB3777	W8JK3475 ZL2VM3472 W6LHN3471	G57.1 267/
W3GHD 38 121	W9UBB3777 W8AQT36120 K4FCV36109	VK2AGJ3470	W5VV2661
W8AU38120 W8LYQ38120	W8AAJ36106	VK2EG3470	W4EQK2661
W8DFH 38 119	W8AQT .36 .120 K4FCV .36 .109 W8AAJ .36 .106 W3GGE .36 .106 W6BAM .36 .106 W8DOD .36 .105 W9AFN .36 .105 W5PJ .36 .105	VE5MZ3469 VK2VN3463	W8QDU2661 W9NMH2661
W9PST38119 W8QXT38119	W8DOD36106	W9QOE3456	W5DNV2660
W8.IIN 38 119	W9AFN36105	F8XT33112	VK20Q2656 W4TS2654
W3FQP38119 W8DWV38118	W5PJ36105 W8QDU36105	W8ACY33106 W3DAJ3397	W6MPS2651
W1GDY38118	W5ASG36104	W6KEV3396	VE4SS2650 W6FKK2647
W1GDY38118 W2BMX38118	SP1AR36103	W8BWC3393	W7AMQ2647
W1BGC38117 W6AM38117	W6NNR36100 W6KWA3699	W6KUT3390 W6CEM3388	K6LKN2646 G6CL2646
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DX AND OVERSEAS NEWS

by Herb Becker, W6QD

Send all contributions to Radio, attention DX
Editor, 1300 Kenwood Road, Santa Barbara,
Calif.

Last December Radio sponsored its first World-Wide DX Contest and following will be found the final roundup of scores and pertinent facts of the contest. Just to refresh your memory regarding the rules of the "WW" Contest, it will be remembered that a station could work another station anywhere else in the world. A station received 3 points for working another one, providing it was on a different continent than his own. All contacts on his own continent were counted as 1 point. There was the usual country multiplier which we have been used to having, and on top of this we added a zone multiplier. This proved to be quite good as it added an additional incentive for the gang to check in as many zones as possible. It was unfortunate for everyone that the war had to begin just as the rules were announced, with the consequence that many of the fellows lost some interest and did not show up on the air again for some time. Probably the greatest miscue on our part was the fact that Radio



Certificates like this one go to the winners in each call area and country.

did not reach the foreign countries in time for them to read the rules. This of course led many of the foreign stations to work only W stations as they had been in the habit of doing in the A.R.R.L. contest. I might as well bring up at this time that next month in the July issue we

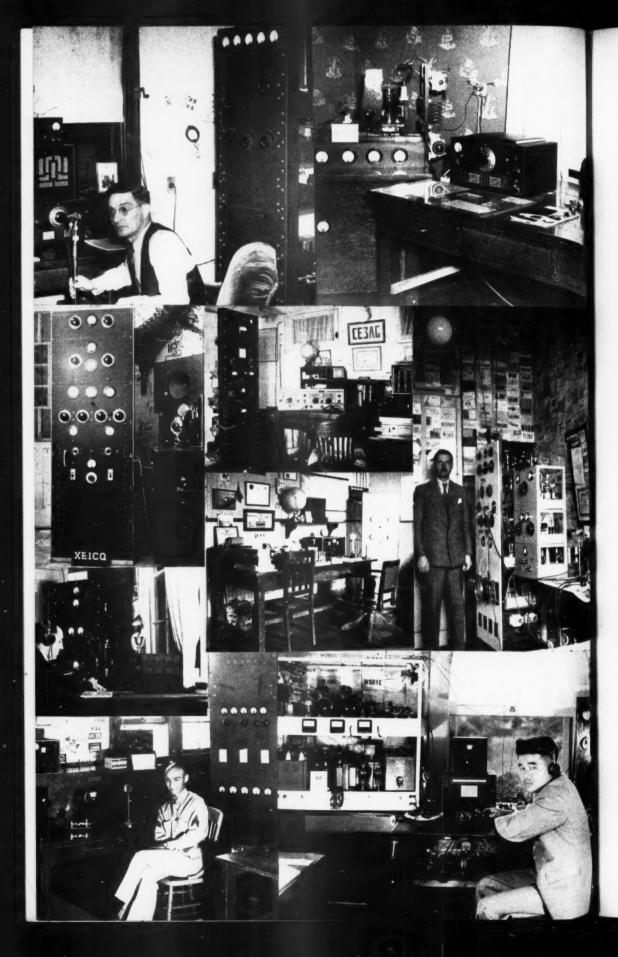
WINNERS 1939 WORLD-WIDE DX CONTEST

Radi	iotelegraph	Division
United States	**************************************	1RY 58,032 2UK 138,564 3FQP 71,286 4QN 34,200 5KC 143,640 6GRL* 359,100 6QAP 143,424 7DVY 49,248 8OQF 160,680 9GDH 147,972
Brāzil Chile China Ecuador Haiti Hawaii Hungary Italy Japan Korea (Chosen Mexico	H 	72GS 30,36C E4AD 67,221 U8MI 68,42C C1FG 144 H2MC 1,24E GCGK 319,40C A8D 25,431 IR 12,67S J 122,474
Netherlands Indies (Born Philippine Isla Puerto Rico Salvador Uruguay Yugoslavia	ndsK	A1PO 18,920 DTH 202,500 S2LR 2,190 K2AJ 155,624

* W6GRL receives certificate for the more-thanone operator division.

Radiotelephone Division

United	States	*****	W1FOV 15,184 W2DYR 13,552 W3BET 24,102 W5EDX 18,139 W6OCH 254,880 W7AMQ 1,656 W8LW 54,096
			W9BEU 49,248
Alaska			K7HCX 264
			LU7BK391,136
			CP8AI 260
Brazil			PY2AC 21,098
			CE3AG618,896
China			.XU8AM 27,430
Ecuado	r		HC2CC 43,860
Hawaii			K6BNR463,176
			J2NG 18,630
Mexico			XE1CQ 77,700
Nether		200)	PK5KF 8
			OA3B 26,460
			KA1LZ573,002
			ZP2AA 756
rarayu			CX2CO143,106



will print the rules for the 1940 World-Wide DX Contest. This contest will be in early fall, possibly October, and the rules should be able to

reach the most remote points.

Looking over some of the high ones in this contest we find W6GRL leading off the c.w. division with 359,100 points. Doc not only was high in the country but in the world—this of course in that division. GRL made 146 contacts in 21 zones and 50 was the country multiplier. Doc did most of the operating, but Dave was around some of the time with other guests so he took a hand in a little brasspounding. Doc got mixed up one of the week-ends and had a lot of folks around the house, or otherwise he might have done better. Speaking of Dave, W4DHZ, he hasn't been doing much brasspounding and is again getting an itchy fist. Word has it that he is looking for one of those "spots" and so maybe we will hear him blazing away by the time of RADIO's contest.

The highest c.w. station outside of USA was K6CGK with 319,400 points. Kay had 288 contacts in 13 zones. His antennas consisted of a V beam and a 4-section 8JK. Next in line was K4DTH with 202,500. Jose's contacts numbered 508 and zones were 15. He used a vertical the first week-end and the second he used a 66-foot

W2UK didn't have much time but did get on enough to run up 138,564 points. Tommy made 81 contacts in 19 zones. While talking about W2UK, he made mention of having a contest only for yl's and xyl's. Says he bets his would come out on top. Any takers?

W5KC is one of the most consistent contest operators in W5 and made 80 contacts in 18 zones. The points added up to 143,640. You can get a look at Vincent's station in one of the

photos shown in this section.

In the W6 area W6QAP took the honors for single operator division with 143,424. Bud was in Tucson at the time and had a heck of a job getting organized. His exciter, which was built at the last minute, konked out on him and by the time he rigged up something he was so exhausted that he slept most of the first 24 hours of the contest. Anyway, Bud did very well and does not have to apologize for the score. Bud has located in L.A. and in a few more weeks will be a "native son."

I suppose I might mention at this point that W6QD is not eligible for any award, although he had just as much fun as the rest of you. The W9's were very few and far between.

W8OQF made 88 contacts in 20 zones and scored 160,680 points. Ralph did very fine work and claims not to have lost too much sleep. W9-GHD came out first for the W9's with 147,972. Zones numbered 19 and the contacts 73. Station pictures of these two may be found in the column nearby.

WIRY was the best up in the W1 area with 58,032 points. There were not very many competitors in this district so I guess we should give them a fight talk before the next brawl gets started. W2AIW did nice work in getting 75,230 points. W4QN with 34,000 took it for this district with W4FIJ giving him a run with 31,000. Not too much activity here either. W6VB forgot to get started until the second day but ran up 92,880. Up in the northern part of the state W6NGA grabbed off 78,387 points. For some reason or another most of the activity around the S.F. bay is phone, and the c.w. stations are few and far between. W8ZY got 72,000 points out of the contest, and would have had more but for misunderstanding the rules. He worked a lot of the same stations the second week-end that he had the first. W9GKS did exceptionally well in get-

ting 95,000 for second spot in the 9th district. Outside of USA LU9AX grabbed the LU honors with 160,182 points, followed by LU2CW. LU7AZ didn't get into it this time but he claims he will make it up in the fall. Old faithful CE4AD was heard banging away in there all the time getting his 67,000 for first place. HC1FG wasn't on c.w. much, but she was loud in praise for the type of contest we had. Most of the boys out of the country were of the same opinion because they could work anything they desired. In K6 we mentioned K6CGK was in first spot, but he was given a terrific run for his dough by K6LKN. Dave scored 263,844 points and can always be counted on for his consistency on all

bands.

In Hungary HA8D and HA4H were the only participants. HA8D nosed out 4H with 25,431 points, while HA4H had 24,444. I1IR made 12,675, being the only Italian station reporting. In Japan J3FJ added his points and found he had 122,474, which put him away out in front of J2KN with 29,484. In Korea J8CH and J8CG were heard in there quite often with J8CH copping the honors with 8,460 points. CX2AJ can always be counted upon to add his signal to the rest of them and this time was no exception. Enzo ran up 155,624 points, most of which were from W contacts. We cannot overlook YS2LR

Top left—W9BEU, one of the most consistent phone stations in the band, did all right in the contest. The rig uses a pair of T-125's in the final. Top right—W9GDH scored high in the ninth district, running a kw. into a pair of T-200's. Center left—XEICQ came out on top for Mexico. His transmitter uses a pair of HF-100's modulated by a pair of ZB-120's. Upper center—CE3AG was tops in the phone section for CE. He has a mighty fine looking station, and from the looks was tops in the phone section for CE. Me has a mighty fine looking station, and from the looks of the score both he and the station went to town. Lower center—CE4AC also was in there on phone, doing very well by himself. Center right—CE4AD is one of the best known on the air, in and out of contests. In the c.w. division for Chile he finished first. Lower left—W5KC was up to his usual consistency and finished away out in front for the fifth call area. Bottom left—K6BNR, the station of Emil Rettig. BNR reached a point beyond being hoarse in winning the phone division for K6. Bottom right—K6CGK, c.w. winner in Hawaii. Final uses a pair of 100TH's with a 75T driver, while the rig starts out with a v.f.o. "Kay" says his receiver is an FB7 with 7 degrees of bandspread on 20 meters—fine tuning is done by body capacity.

OFFICIAL SCORES, 1939 WORLD-WIDE DX CONTEST

OF OF	FICIAL SCORES, 1939 W	OKLD-WIDE DX CONTE	ST
RADIOTELEGRAPH	W6MUS6,932 W6OVU4,392	CE3DG171 CE4BH8	RADIOTELEPHONE
1st Call Area	W6SN3,850	GE 1011	1st Call Area
W1RY 58,032	W6RDR3,600	China	W1FOV15,184
W1APA12,168	W6EJA2,160	XU8MI68,420	WIADM14,910
W1WV4,560	W6LGD1,944		W1APQ9,360
WIBFT2,750	W6DHS1,296	Ecuador	W1CJH4,800
W1KMY462	W6MUF576	HC1FG144	WIATE 3,100
W1LMQ96	W6CLZ175		W1WV3
		Haiti	
2nd Call Area	7th Call Area	HH2MC1,245	2nd Call Area
W2UK138,564	W7DVY49,248		W2DYR13,552
W2AIW75,230	W7DWA17,587	Hawaii	W2IUV7,774
W2WC25,875	W7FD11,700	K6CGK319,400	3rd Call Area
W2CJM25,517	8:1 6 11 4	K6LKN263,844	W3BET24,102
W2BQK7,700 W2BO4,800	8th Call Area	K6PAH129,880 K6IAE23,856	W3DE124,102
W2LXI3,456	W80QF160,680	K6QYI7,992	5th Call Area
W2DZA1,710	W8ZY72,765	W6ERQ/K61,776	W5EDX18,139
W2GT945	W8IOT31,590 W8CED28,560	K6PHD1,620	W5HDU1,188
W2DXL 432	W8MOA23,946	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	***************************************
W2JWY100	W8QIZ9,024	Hungary	6th Call Area
	W8PUD8,470	HA8D25,431	W60CH 254,880
3rd Call Area	W8JDG5,148	HA4H24,444	W6RCD94,350
W3FQP71,280	W8NKI2,448		W6AM45,024
W3EPV36,720	W8NCJ1,120	Italy	W6AED35,264
W3ASW 24,794	W8L0F945	IIIR12,675	W6NHK 20,948
W3EMM10,251	W8DAE630		W6MEP 19,506
4th Call Area	W8KPL480 W8FGV400	Japan	W6ITH12,506
	VV 51 GV	J3FJ122,474	W6CHV8,400
W4QN34,200	9th Call Area	J2KN29,484	W6QLN7,436 W6EFC5,280
W4FIJ31,746 W4BJX17,680	W9DGH147,972	J2MH 11,226 J2KI 20	W600Z4,356
W4BYF336	W9GKS95,418	J2K120	W6QGI1,616
***************************************	W9PK34,216	Korea (Chosen)	W6HCE600
5th Call Area	W9VW13,950	J8CH8,460	W6AK570
W5KC143,640	W9GBJ11,880	J8CG3,920	W6EPZ128
W5HQN7,488	W9CWW10,800	,	7.1 6 11 4
W5GRH4,320	W9DGH 10,800 W9VES 10,484	Mexico	7th Call Area
W5ASG192	W9YXO9,240	XE1CM154,583	W7AMQ1,656
*** O !! A	W9WGL8,064	XEILM2,736	Set Cell Asses
6th Call Area	W9VDX6,720		8th Call Area
W6GRL359,1001	W9EKC3,240	Netherlands	W8LW 54,096
W6QD 232,806 ² W6QAP 143,424 ³	W9QMD1,920	Bornco	W8LFE 25,536 W8BF 14,850
W6VB92,880	W9AMM1,764	PK5JT81	W8AAJ9,240
W6NGA78,387	W9ZRP588	BLH:	W80GZ1,519
W6GPB34,112	W9ERU510 W9OKB300	Philippine Islands	W8FGV864
W6BAM33,050	W9ZRO275	KA1PO18,920	
W6PNO29,260	W > E NO	Puerto Rico	9th Call Area
W6NLI20,559	Argentina		W9BEU 49,248
W6EPZ14,274	LU9AX160,182	K4DTH202,500 K4KD15,197	W9ZYL11,505
W6DZE13,632	LU2CW103,680	K4FCV5,424	W9K0H2,520
W6JOH12,348 W6BVM11,760	LU5FB3,696	K 11 CV	W9BDL721
W6FKZ10,080	LU2AW792	Salvador	Alaska
		YS2LR2,190	K7HCX264
1W6GRL receives cer-	Brazil	,.,,,,,	K/HCA204
tificate in the more-than-	PY2GS30,360	Uruguay	Argentina
one operator division	PY2DV2,480	CX2AJ155,624	LU7BK391,136
² W6QD not eligible for award		CX1BG6,741	LU5AN265,950
³ W6QAP receives cer-	Chile	w	LU6DJ65,664
tificate in single opera-	CE4AD67,221	Yugoslavia	LU4DJ 6,380
tor division.	CE3AJ1,305	YU7AY108	LU3HA6,270

1E

DX Scores Continued

Bolivia CP8AI260 Brazil	China XU8AM 27,430 XU1B 8,320 XU8RB 5,760	K6MVA442,017 K6PHD1,260	Netherlands Borneo PK5KF8
PY2AC21,098	XU8ZA3,465	J2NG18,630	Peru
PY2LN735	Cuba	J2NQ10,192 J2KI5,104	OA3B26,460
Chile	CO2WM7,326	J2KN4,160	Philippine Islands
CE3AC509,490	Ecuador	J2NT1,050	KA1LZ573,002
CE3CK132,750 CE4AC27,132 CE3CG22,491	HC2CC43,860 HC1FG3,060	Mexico XE1CQ77,700 XE1AC40,500	Paraguay ZP2AA756
CE3EW11,856 CE2BO10,452	Hawaii K6BNR463,176	XE1FF13,050 XE2GO24	Uruguay CX2CO143,106

who once again participated, giving a much sought after multiplier.

Phone Scores

The highest score in the world was from CE3AG who had 618,896. He made 297 contacts in 16 zones. Receiver was an RME-70, and the antenna for 14 Mc. is a half-wave doublet, horizontal. For 28 Mc. he uses two half waves in phase, vertical, and both antennas are fed with 600-ohm lines. CE3AC gave him a run and gathered 509,490 points in 18 zones. He uses a National transmitter and a Super-Pro receiver.

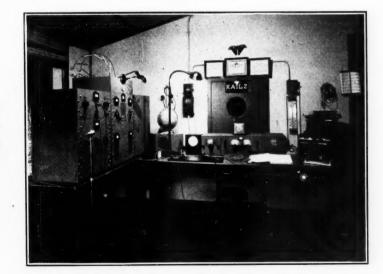
tional transmitter and a Super-Pro receiver.

The highest in the States was from W6OCH in San Leandro, who yelled himself into 254,880 points. Larry worked into 20 zones which is mighty fine . . his antennas run almost all over town, while the rig runs about a kw. input to 250TH's. W1FOV with 15,000 was closely followed by W1ADM with 14,910. W2DYR didn't have much trouble getting 13,000 for the W2's.

W8LW ran up 54,000 for tops in W8, and W9BEU with his 49,000 grabbed the W9's without a struggle. W6RCD, a comparative newcomer in dx circles, really went to town in Southern California rolling up 94,350 points in 17 zones.

Getting out of USA, we find KA1LZ making a fine showing with 573,000 points. His log, pictured herein, was the longest turned in . . . being typed on a sheet of paper 14 inches wide and 8 feet long. Luigi made 323 contacts in 19 zones for this imposing total of points. His rig lineup is as follows: 6F6G crystal oscillator into parallel 6L6G's doubling to 20, then into a 35T which drives a pair of 250TH's to a kw. input. For 10 meters another 6L6G is switched in after the oscillator. All final plate tank leads and coils are silver plated with a noticeable increase of efficiency, especially on 10 meters. KA1LZ uses a dynamic mike, and the class B stage uses a pair of 250TH's also. The antenna setup is im-

KAILZ, radiotelephone winner for the Philippines. Left cabinet contains speech equipment and exciter, center cabinet contains 250TH final on top and 250TH modulators beneath, and right hand cabinet houses power supplies.

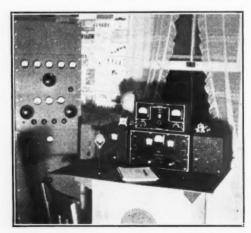




The DX Editor casts a speculative eye at KA1LZ's log. The logs arrived in all sizes and shapes and in all forms of legibility and illegibility. This one was typed on a sheet of paper 8 feet long.

posing. For 20 he has a 4-element array on a tower 92 feet above the ground . . . and 10 meters is handled by a compact dual H beam by 8JK and 8RNC as described in October, 1939, RADIO. Receiver is an RME-69 and a DB-20.

LU7BK went to town and wound up with 391, 136 points—zones were 16 and number of QSO's 268. Not far behind him was LU5AN with 265, 000 points, 15 zones and 219 contacts. As men-



K6MVA was right on K6BNR's heels all the way and the closeness of their scores indicates quite a race.



W6RCD was the highest around southern California in the phone division and second high in the district. The rig uses a pair of 100TH's in the final and starts out with an X-EC.

tioned before the CE's were very active on phone, 7 of them reporting with logs. XU8AM led the XU's with 27,000 points. HC2CC was quite active and turned up with 43,000.

K6BNR had his hands full in keeping ahead of K6MVA, that is if you can judge from the score. BNR had 463,176 while MVA ended with 442,000. BNR made 322 contacts in 18 zones while MVA worked 341 stations in 17 zones. The difference between the two was in zones and country multipliers. BNR had a country multiplier of 28 and MVA had 27. Notice the photos of each station. CX2CO was the only one reporting from Uruguay and he had a nice total of 143,106. From Mexico XE1CQ came in first with 77,700, with XE1AC in second spot.

All in all I believe the gang was satisfied with our first effort at a dx contest. I sincerely hope that everyone will cooperate again in spreading the word to the other countries regarding the rules of the next contest. Much will be done by printing them sufficiently in advance for this next one. The July issue will contain these rules for the 1940 World-Wide DX Contest.

Marathon Omission

W8CED was omitted from the final scores of the 1939 DX Marathon. He should have been in 38th position with 34 zones and 91 countries. We regret that this had to occur in this final and last reckoning of scores, because Lee had been so consistent in reporting from time to time. He, above all, should have been included. But, as has been said before "To err is human," so I guess that more or less establishes us in this category. W8CED will receive his certificate accordingly.

8th DX Roundup . . . W1SZ Guest of Honor

On April 17 a DX Roundup was held in Los Angeles, with Clark Rodimon, W1SZ, as guest of honor. It was a swell turnout of dx men and Roddy met many of them personally. Most of them had worked him during the past few years. There were 150 dx men present and I must say

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W8OQF used c.w. with 150T's in the final. He was tops in the 8th call area.



W2UK and xyl. Tommy's rig has been shown so many times we thought it high time the "happy combination" was introduced. She's actually the power behind the guns.

the power companies took a big loss that night with all of those kw's off the air. Roddy gave us a few highlights on east coast doings, Bill Eitel, W6UF, gave a talk on one of the subjects he knows best, tubes. Dave Evans, W4DHZ/6 discussed antennas with the boys. Johnny Griggs, W6KW, gave a little dope regarding the Antarctic situation, while Leigh Karaki, who operated at J2MI and XU8OZ, went into ham radio as found in Japan—and all about their 20 watts allowable input. It made some of our California kw's shutter after he finished. "Yours truly" acted as MC the best he could, although it was quite a busy day.

(In all the years that W6QD has been conducting this column, the editors have left this space strictly alone, figuring that it was more or less Herb's "private property." However, the events of April 17, as revealed by Herb's private operative no. 1492, are sufficiently important and informative to warrant our muscling in for a moment.

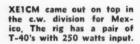
It all started on Tuesday, April 16, when Roddy, W1SZ, arrived in Los Angeles and W6QD and a gang showed him a few ham stations—and other places. Early the next morning Herb blearily groped his way to the airport to meet Bill Eitel, W6UF, the "Ei"

K6LKN finished right behind K6CGK and did a lot of fine operating, Dave is very consistent on phone as well as on c.w.





W60CH — operator, Larry Barton. Transmitter runs a kilowatt into a set of rhombics and phased arrays, Receiver is an RME-69 with DB-20,





part of Eimac, who was to speak at the DX Roundup to be held that evening, with Herb as MC. After this chore he rounded up the rest of the speakers, arranged for prizes, and located and installed the p.a. system in the meeting hall. All this in addition to the regular daily chores. This would be enough to keep anyone busy, but Herb had even more important business to attend to on that day. He was pacing the hall in a Los Angeles hospital awaiting the arrival of . . Linda Jean Becker, 7 lbs. 2 ozs. The yl. and xyl are doing fine; in fact Herb says they're both "42 db above R9."

We know that our readers will join with the staff in heartiest congratulations to Herb and the xyl on the new arrival. Incidentally, Herb has a new job—other than handling the DX Dept. for RADIO—still in the amateur field of course. With that we will step out and turn this space back to its rightful owner.)

What Is DX?

I'll bite, what is dx, or maybe we should say "where is it?"

One thing we can be sure about and that is [Continued on Page 94]

The Amateur Newcomer-

Transmitting Antenna Vs.

B. C. L. INTERFERENCE

By VICTOR RUEBHAUSEN, * W9QDA

During the past three years the author has used a number of different antennas for operation on the 10-meter band. In making changes to improve the signal, effects upon b.c.l. interference were carefully observed.

Re-

say

interference were carefully observed.

The amount of b.c.l. trouble experienced is a fairly good indicator as to the efficiency of a 7-, 14- or 28-Mc. antenna system. The type of interference referred to is that present when an intense field appears around the broadcast receiver. The strong unwanted signal is rectified by the second detector or elsewhere in the receiver and oftentimes raises havoc with b.c. reception. But no remedy should be needed on any receiver if the transmitting antenna system creates little field strength in the vicinity of the broadcast set or its antennas (28-Mc. operation). It should also be borne in mind that at increasingly

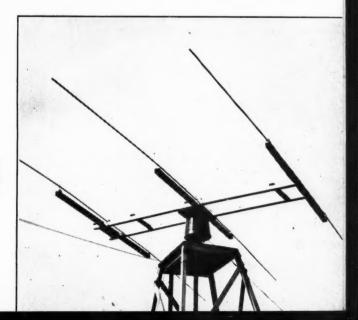
higher frequencies the amount of radiation from nearby objects goes up too. Reradiation, of course, increases the field strength in the vicinity of the antenna, with a consequent increase in b.c.l. interference. Amateurs, particularly those living in apartment houses, would be wise to suspect all surrounding objects until they are proven innocent of reradiation.

The reports on various antennas tried by the author were tabulated with readings of a field strength meter and the observations made by local 10-meter stations in the immediate vicinity.

The first antenna to be tried on the roof of the apartment house was the simple half-wave doublet. The feed line consisted of 50 feet of high grade 72-ohm cable. The final amplifier in the transmitter had an input of 500 watts. The results with this arrangement were mediocre for communication work, while

* 7434 No. Oakley Ave., Chicago, Ill.

The three-element rotary (before the guy wires were broken with insulators) which finally reduced b.c.l. interference to a minimum.



severe b.c.l. interference was caused throughout the apartment building. The normal radiation pattern of this half-wave doublet was such that there would be considerable field strength anywhere in the vicinity, regardless of direction. Some improvement resulted when the antenna was raised above and clear of all surrounding objects by at least 16 feet.

After using the doublet for several months it was decided that the results left considerable to be desired. This time two half-wave antennas in phase were tried, using a quarterwave matching stub at the center to phase the radiators. The 72-ohm cable was inserted in the low impedance, or cold end, of the quarter-wave matching section. Signal strength reports from amateurs were better broadside to the antenna, while off the ends the reports were less complimentary. B.c.l. interference cleared up only slightly from that noted while the doublet was used. Considerable improvement in signal reports resulted when a balanced, open-wire feed line replaced the 72-ohm cable. Interference increased until the standing waves were removed from the feed line and the stub was properly matched to the antenna. In the favored directions, results were quite satisfactory for a transmitter with 500 watts input to the final amplifier.

About this time W8JK's flat-top arrays were gaining considerable well-earned popularity; so a double-section "8JK" for 10 meters was strung between the poles that formerly held the two half waves in phase. The stub from the other antenna was removed and attached to the new array at the center, while the same feed system was used with only a slight amount of pruning necessary to remove standing waves. The results were so gratifying that the final amplifier input was reduced to 250 watts. Again the broadside directions were favored but this time by a greater amount. Reports universally improved while the b.c.l. troubles dropped to a low level. This antenna was guiding the r.f. in specific directions instead of all over the neighborhood.

Lastly, the extremely popular three-element rotary was constructed. In comparing it with the performance of the other antenna, it is necessary only to say that the final amplifier power was reduced this time to 100 watts, with excellent reports.

Following the installation of the rotary beam, systematic efforts were made further to check antenna performance both as to field strength and interference. The first step was to set up a field strength meter in a neighbor's apartment and simultaneously to observe its readings and to listen to the interference in the b.c.l. receiver. With the transmitter turned

on and the beam rotating, the field-strength meter indicated a series of rapid fluctuations. The modulation on the transmitted signal became quite noticeable in the b.c. receiver when the f.s. meter indicated a peak. The first corrective measure was to break up, with insulators, the three guy wires supporting the 17-foot tower holding the array. Another check with the f.s. meter while rotating the antenna revealed that breaking up the guy wires had halved the number of variations. The next undertaking was to remove all of the broadcast antennas to another part of the roof and to reinstall them so that they were no closer than 20 feet from the beam elements. This reduced the field strength within the building to a minimum, except when the antenna was pointed to the south. The reason for this exception was a complete mystery until it was remembered that assistance had been rendered to a shortwave enthusiast in a building in that direction by way of installing a 40-meter single-wire-fed antenna, which was resonant on 10 meters as well. Shortening the latter by several feet brought about the desired effect, inasmuch as the field strength meter read zero regardless of the antenna's position. Needless to say, b.c.l. interference had disappeared.

All these alterations were made over a period of a month or so; and with each change that reduced the field strength in the building, the pattern of the antenna as it rotated was reported to be more normal. These checks were verified by stations within 20 miles. In addition to the improved pattern, the forward gain was about 6 db better than it had been prior to the removal of the reradiating material.

There are very few types of antennas that will remain properly matched over a band as wide as our 10-meter band; for this reason care should be taken to operate at or very close to the frequency for which the antenna is adjusted. Unless this rule is carefully observed, b.c.l. interference may be severe in the vicinity of the antenna. The field strength surrounding the antenna, of course, will rise with the amount of mismatch developed.

Considerable care should be exercised in judging the "fundamental frequency" of the antenna, particularly if deductions are made from signal reports obtained from other stations. It can easily develop that an antenna is reported as producing "maximum signal" on a frequency well removed from the resonant frequency, due to resonance effects of the antenna being used on the checking receiver.

[Continued on Page 72]



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E. H. CONKLIN, W9BNX*

The big news of March and April was the ionosphere storms that churned up the layers and brought u.h.f. communication of the aurora type. Visible aurora and heavy magnetic storms accompanied the ionosphere irregularities. On several occasions, the Wednesday reports of the National Bureau of Standards indicated severe dis-turbances and, on March 27, they could not even measure any regular layer structure.

On Easter, March 24, ten-meter transmission over long F2 layer paths gave way to short skip and then to skipless aurora flutter, according to several observers who have provided very complete reports. This condition brought considerable aurora-type skipless five-meter dx over a large part of the country but, in general, only those using c.w. could be understood because of modulation effects on all signals.

Easter at W9ARN

A detailed report from W9ARN in Bartonville, Illinois, indicated that K4 on ten meters and Army Amateur work on 160 seemed normal in the morning. At one p.m., the west coast had gone out on ten, though W6BOY mobile off Panama, YV4AE, K4DTH, some CE and LU stations came through weak and fading, with a high frequency buzzing over the entire band. In half an hour, signals decreased while the buzzing became worse. Still later, weak W4-8-9 stations came through with a flutter, followed by the east coast by 3 p.m., and a clearing up of the flutter. An R9 contact with W2MPA broke up sharply. At 4 p.m., the W4's were hard to read, and the buzzing so badly that Jack took his car out to check the nearby power line for leaks. At the airport, he found that the teletype had gone haywire and receiving conditions were not normal, with messages indicating similar troubles elsewhere.

At 6:15, ten was wide open with very loud signals. At seven, W9ZHB reported five-meter dx starting to come through and Jack heard peculiar sounding c.w. from W3DI EIS W8CIR W9GGH, the last two working each other. There were some unreadable carriers. W8VO was heard working a W2 at 8:20, with all of the signals coming directly out of the north. W8CIR men-tioned the same peculiarity. At nine, ten meters was still good to the east and for 500 to 700

miles in other directions. At ten, five-meter c.w. signals from W2AMJ W3DBC BZJ W8LKD were heard, then a phone was made out, "Standing by for W9GHW at Kirkwood," Missouri. After ARN logged W8CLS TIU NYD on c.w., W9FHR came into the shack and worked out a keying system that would permit some contacts. Around eleven, they raised W8LKD in Ohio, W8TIU QQS in Saginaw, Michigan, for two new states, using the beam north. Signals were fewer, and without much fade. After midnight, W8CIR was raised with best signals using the beam northeast at ARN and due north at CIR. Ten meter sigs then were coming in from Minnesota, Nebraska, and the Dakotas and had a flutter again. In addition to being an interesting "serial" on conditions during an aurora display on conditions during an aurora display and heavy magnetic disturbances, Jack's letter impresses one with the necessity for a c.w. carrier keying provision in five-meter transmitters. More comments on who worked whom, will be found in the five-meter section.

In Hugo, Oklahoma, W5TW noticed so many queer things in late March that he wonders whether the wrong theory is being applied to u.h.f. work. Ten-meter signals went out east and west, but not north and south although wire line troubles were the reverse. On 2½, signals went out at fifty feet east or west, but were good at several miles north or south! Ed points out that the theory of light was changed twice-and even his old tom-cat returned after the aurora spell.

The Total Eclipse

W5TW decided to listen on 10, 5 and 21/2 and to check conditions during an eclipse by transmitting on ten and 21/2. In the morning, ten was dead as usual, five sounded alive with no signals, but 21/2 mobile rigs were good until noon when they got weak and ununderstandable. At that time, 26 five-meter signals came in with a high noise like a hiss that prevented identifica-tion. Ten came to life at 1:10 Central time with a few weak signals. By 2 p.m., five was out with no more hiss but K6 and South American signals were good.

At 2:12 as the eclipse started, W4-5-9 came through, with Texas and Oklahoma signals loudest. A car was sent out at 3 p.m. to discover what was wrong with a 21/2-meter job, and it was found that signals were out until the rig was in a valley, two miles away! At 4:30, things reversed themselves with 10 going out, five bringing in weak carriers, and 2½ working only from the hilltops. Shortly after, at 4:58, a flut-ter appeared on 2½ and this band passed out, leaving all three bands dead.

Antennas

Fred Bornman, W8QDU, comes out with different figures than W9PEI for the W.E. concentric-type vertical antenna. Fred has a longer skirt (that is, the concentric, lower half of the antenna), using the equation 221/FMe. for the upper section and 243/FMc. for the lower. Fred runs the concentric line a quarter wave below the skirt, matching with a quarter-wave transformer into an open wire line. This gives a 1:1.2 ratio of standing waves on the line, with equal line currents. This particular set-up is complicated, what with the half-wave concentric line, the unbalanced-to-

^{*} Associate Editor, RADIO, Wheaton, Illinois

balanced connection, and the quarter-wave transformer, so the straight-forward problem for concentric line feed is not answered. Incidentally, a further factor and apparently a great help at QDU is the group of horizontal quarter wave radials placed a quarter wave below the antenna.

W1JFF says, "For five meters, give me a vertical antenna if I can't have a rotary beam; there are too many cq's called and not answered otherwise." That is just the opposite of the situation

in Central Illinois, of course.

W8QDU points out that a beam sharp in horizontal directivity will discriminate against noise, provided that the stations worked are not in the direction of maximum noise generation. He feels that constructional advantages favor a simple, but high, vertical antenna. He mentions W8JLQ who replaced a horizontal insulatorless array with a vertical and began to hear ground wave dx (vertically polarized transmission) for the first time. Fred does not like the idea of some fellows using one polarization and the rest using the other, splitting the ground-wave dx into two groups. He is going to run some tests with W8CVQ, who feels the same way in view of the absence of congestion on five meters now.

While verticals are most common for mobile work, there is a distinct advantage in concentrating on this one polarization. When terr-meter long skip goes, and short skip is less frequent during the next five years, concentration on verticals for this band also may become advisable. It is not hard to build a stacked horizontal mobile array for 2½, but let's not bring that up

just now!

The experience of W8CIR in finding a Yagi 20 feet high superior to a simple vertical 80 feet high has been explained by the fact that Ed is on a hill where anything is well in the clear; the added height just increases the horizon whereas the beam increases power and produces much the same result. At lower locations, there may be no substitute for height for ground wave

Ed Harris, W5TW, suggests both horizontal and vertical beams on a mast, fed together. Yeah, but unless they are fed at 90 degrees phase relationship, they result in 45 degree polarization which can be resolved into half the power on either polarization; if they are fed at 90 degrees phase relationship to give circular polarization, the result still is to divide the power in half for either polarization. Perhaps it is better to choose one and stick to it, except for diversity reception of skip signals to reduce or eliminate fading.

Wave Propagation

A review of radio progress in 1939 published in the IRE Proceedings contains these comments:

A remarkable aspect of progress was the development of formulas for the calculation of field intensities which are valid for both low and ultra-high frequencies and, in fact, for ground-wave propagation at all frequencies. The work of recent years on ultra-high frequencies has led to this advance in understanding of the propagation of radio waves at all frequencies.

The theoretical formulas for ground-wave calculation were brought to a new stage of accuracy. Some of the results of these studies were given in graphical form, for a number of frequencies and ground conductivities and for transmitter and receiver on the ground. These and previous studies were for vertically polarized waves. A theoretical solution for the propagation of horizontally polarized waves appeared (M. C. Gray, Phil. Mag., April, 1939—Ed.); it showed that the values of the ground constants are of much less importance for horizontally than for vertically polarized waves . . . It is probable that the calculations of instantaneous groundwave intensity over great distances never can be highly exact because there is one factor, atmospheric refraction, which varies unpredictably (this is the borderline of tropospheric waves reflected by air-mass boundaries—Ed.)

Equipment

Some fellows think that they must have a modulator power equal to half of the transmitter input in order to get on the ultra-highs. Who started that idea? A little voice will modulate a rig heavily on peaks, and there seems to be no objection to a little extra carrier. Some transmitters, particularly oscillators, have a modulation capability well below 100 per cent, and can not legally be modulated in excess of it. How many really have checked this little point? Anyhow, use what you have in the r.f. end of the rig, and modulate with what you can scare up, even if it is only 20 per cent, and come on down to these wavelengths. C.w. and i.c.w. are o.k., you know.

O. K. Falor, operator at WBCM in Bay City, Michigan, says that he has solved the problem of cheap concentric lines. He uses 28 gauge copper sheet for the outer conductor, and standard sizes of wire or tubing for the inner conductor. His method of bending the sheet for the pipe is to clean and cut it square, leaving about a quarter inch for overlap when bent; then to bend it evenly along its entire length around a rolling pin. It can be tied down with string until the seam is spotted with solder at several points. If a solid iron heated in a gas burner is used, solder will flow into the whole lap.

A variation of this for other sizes is to roll the sheet copper around something, then to compress and feed it through a round hole in a board, soldering as the pipe comes through.

Cheap U.H.F. Tube

Falor points out that for those who want to try the ultra-highs for 50c rather than to buy acorn or HY615 tubes, the type 55 and its 6-volt equivalent, type 85, are quite satisfactory. These are double-diode triodes of which the modern version is 6R7-G, the advantage being the low interelectrode capacities and the triode grid coming out the top. Using one of these tubes in a single-ended 2½-meter oscillator, he has had good results. The grid is tapped through a 50,000-ohm grid leak and .001-µµfd. condenser to a 16-inch concentric line 7½ inches up from the

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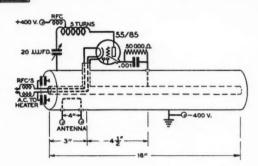
shorted end. Three inches up, the cathode is tapped on the line, e.c.o. fashion, with a quarter inch tube. The heater wires are pulled through this and the lower part of the center conductor of the line. The plate could not be grounded with ordinary condensers, so was series-tuned with a five-turn coil and 20-\mu\mu fd. condenser, 400 plate volts being fed through a choke to the node on With this arrangement, the plate curthe coil. rent dips down to a 6 ma. and loads up, either with a 4-inch hairpin to the grid line or inductive coupling to the plate coil, to 30 or 40 ma. That is 16 watts input, at good efficiency, for a 50c tube, 50c line and very little else! The plate tuning has been avoided by RCA by use of a mica-and-sheet-copper by-pass condenser plastered against the outer conductor, to reduce inductive reactance. A similar circuit with a pentode, using the screen as a triode plate, and the output coupled to the actual plate, may even be stable enough for five-meter phone. With one type 55 tube, Falor found that the grid line did not take over control, but oscillations took place on 226

Incidentally, use wide copper strip or tubing for all taps and connections in short line oscillators, in order to avoid peculiar effects. A recent rig at W9BNX would not be controlled by the grid tank until the wire used for the grid taps and leads was replaced with ½-inch wide strip.

Another suggestion is the use of cheap "GE" 30-watt round bulbs, obtainable at the dime store, as a resonant load on 2½. It is necessary only to touch the inner conductor to a tank in order to light the bulb—if you have enough power. Hand capacity was found to be unnecessary. Another test with a variety of bulbs from ten to twenty-five watts showed that they all worked, but some would match better and take more load.

In RADIO for February, page 17, an RCA kilowatt oscillator—stable enough to be keyed—was mentioned. This uses a large concentric line, with grid and filament loops within the line, the plate being grounded. The tube and loops are mounted on a plate that covers a hole in the line's outer conductor, making changes in tubes, loop sizes and frequency very easy. The following is a quotation from RCA's letter giving actual data on the mechanical layout:

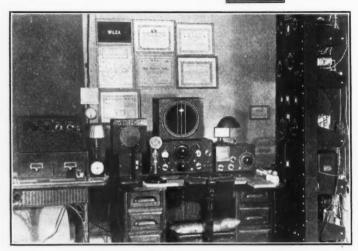
"The size of the grid and filament coupling loops were in this particular case about 6" high by 6" long. The width of the grid loop was about 2", being made of 1/16" thick copper strip. The cross section of the filament loops is not so important. These were each ½" by ½" copper. The filament loops enclose about 75% of the area of the grid loop. Care must be exercised that no magnetic flux is looped between the filament leads themselves. This would overheat the filament and result in low transmitter efficiency. The loops should be constructed so that the broad surfaces are parallel with the electromagnetic flux. The size of the grid loop depends on the frequency and to some extent upon the general construction of the unit. The proportion of the grid loop area enclosed by the filament loop depends to some



O. K. Falor's 2½-meter transmitter using a 55 or 85 tube.

56 Mc. DX HONOR ROLL					
Call	D	S	Call	D	S
W9ZJB W1EYM W3AIR	9* 8 8	18	W1JFF W1LLL W2KLZ	6 6 6*	11
W3BZJ W3RL W5AJG	8 8 *	27 24 29	W2LAH W6QLZ W8LKD	6	11
W8CIR W9USI	8* 8	29 22	W80JF W9NY	6	13
W8JLQ W8VO W9ARN W9CBJ	8 8	17	WIJMT WIJNX WIJRY	555555555	9
W9ZHB W1HDQ	8* 7*	29 18	W1LFI W2GHV W3GLV	5 5 5	8
W2AMJ W2JCY W2MO	7 7 7	22	W3HJT W6DNS W6KTJ	5 5	
W3BYF W3EZM W3HJO	7 7	24	W8EGQ W8NOR W8OPO	5 5*	10 16 8
W4DRZ W4EDD	7* 7*	22	W8RVT W9UOG	5 5 5	7 8
W4FBH W5CSU W5EHM	7 7 7	20	VE3ADO W3FPL	4* 4	8
W8CVQ W8PK W8QDU	7 7* 7	9	W6IOJ W8AGU W8NOB	4* 4 4	8
W9CLH W9SQE W9AHZ	7 7 7*	22 14	W8NYD W1KHL	4* 3	
W9BJV W9CHG	7 7*	12	W1LKM W6AVR	3	5
W9WAL W9QCY W9ZUL	7 7 7	10 16	W60IN W60VK W7GBI	3 3	3 4 4
W9GGH W1CLH W1DEI	7 6 6	13	W80EP W80KC W9WYX	3 3	6
	-	ada. (ı	reported in	1939)	

Note: D-Districts; S-States



W1LEA, Lawrence, Mass. On 21/2, 10, 20 and 40 — the three-band transmitter for the lower frequencies uses a pair of 35T's with 500 watts. 21/2-meter rig uses 35T's with 200 watts input.

extent on the multiplication factor of the tube. These loops were used with an 846 tube in a line 48" to 60" long and 16" i.d. The inner conductor was $4\frac{1}{2}$ " o.d., both copper tubing.

"Smaller lines and higher frequency tubes have also been used by us. These of course require proportionally smaller grid and filament coupling loops.

"In most of these transmitters the tube leads formed part of the coupling loops. In the type of construction where the glass end of the tube extends in through the outer coaxial conductor, care should be taken that no closed loops in the tube link the magnetic flux, which if such were the case might damage the tube."

Interference from superregen receivers is still bad on 2½ in congested areas. O. K. Falor was able to get several watts out of a carefully adjusted type 55 superregen detector on this band, which is comparable to the power of many small transmitters. A question has come up about the legality of using such a receiver if the quench oscillator modulates the detector in excess of the latter's modulation capability, in view of F.C.C. regulations. Perhaps troublesome cases could be urged to do something about radiating receivers by using such pressure.

Some of our readers have intended to make their own acorn sockets with built-in by-pass condensers, but do not know where to obtain the necessary clips. RCA will provide them. If they are not in the acorn tube box at the time of purchase, write RCA Radiotron Division at Harrison, New Jersey, and they will be forth-coming.

Superheterodyne Adjustment

John Voliva, W9VEK, wrote from Indianapolis about one of those organ pipe superhets described in RADIO for June, 1939. It did not work worth a hoot, and help was wanted. After a few letters, he advises that it is now working fine and is more than satisfactory. W9AQQ says

that it is better than his commercially built 5-10 receiver, so he is going to build one up right away. VEK's difficulties may be encountered elsewhere, so some comments on checking superhets are in order.

Starting with the oscillator, check to see if it oscillates over the whole range. A long cathode tap to the coil can give trouble. The plate current should jump when the coil or grid is touched, at any dial setting. Oscillation can be stopped by too heavy loading by the mixer. The output of the oscillator is important but cannot be checked here without building up a v.t. voltmeter and without some knowledge of the required output voltage.

Going next to the mixer, grid injection gives greatest interaction of grid tuning on the oscillator, but requires least voltage (tap close to ground on oscillator coil, or use small coupling condenser) from the oscillator. Suppressor injection can be free of interaction provided that the grid circuit of the mixer is entirely shielded from the suppressor and plate circuit. Often, the suppressor can be connected directly (through a short lead) to the oscillator cathode tap. grid injection or leaky injection connected to another element, the mixer can be biased close to zero, then driven up to recommended detector plate current. With the 954, this calls for about -6 volts on the control grid or a 20,000-ohm or larger cathode resistor. The plate current should be driven up to 0.1 ma. by the oscillator. If the oscillator is thoroughly shielded from the mixer grid, using suppressor injection, no bias or grid current will develop in a leak inserted in the mixer grid, in which case it may take 40 volts from the oscillator for optimum conversion gain, according to W9GFZ. This can be checked by output when listening to a local crystal harmonic.

The antenna can now be coupled to the mixer to check superheterodyne reception. If o.k. to this point, the r.f. stage can be fired up. In u.h.f. rehe or es

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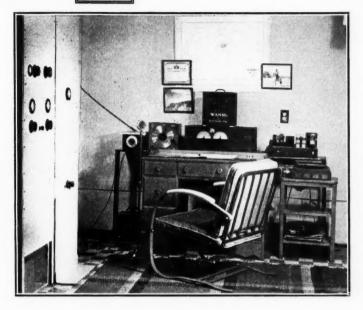
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W8MSG, Bud Shafer, Cleveland, Ohio. The rig uses a pair of 100TH's in the final with 500 watts input on 10; modulators, 203Z's.

ceivers, oscillation may be caused by poor layout and shielding, inadequate by-passing (resulting from too much inductance in the by-pass condensers), or use of a poorly by-passed cathode resistor. If the stage oscillates, it can be stopped generally by tapping down on the tuned circuits, or ruining them with a resistor of a few thousand ohms placed across them. Oscillation can be checked by plate current when the grid is touched, if there is a high resistance leak placed in the grid circuit. The effect of a cathode by-pass condenser can be checked by lowering plate and screen voltage, and shorting the cathode resistor, to see if undesired oscillation stops. Another way to check poor grounding is to take off the antenna, turn on a local oscillator, and touch supposedly by-passed points with a screw driver; an increase in received signal shows poor grounding.

The i.f. amplifier can be checked by listening to signals, when an antenna is coupled to it, or by replacing it with a handy receiver for comparison of gain.

28 MEGACYCLES

W9QDA finds that he can hear W9ZHB, about 100 miles away, seven R's above the noise, when using the little acorn-tube concentric-line converter that he described in the May issue of RADIO. On QDA's regular receiver, ZHB is down in the noise, 70 per cent readable when no car is passing.

QDA put W9QIB in Indianapolis and a W8 in New York on the Chicago telephone during a tenmeter three-way in April on one of those peculiar reflections in which all beams turned south-east. No other stations were coming in except a K4 on normal F₂ layer hop. Ordinarily, Indianapolis is in the skip zone for Chicago, except for unusually good extended ground wave dx or auroratype communication.

W9AI has decided to go into the business of manufacturing concentric line converters, with built-in power supply, promising a layout providing good shielding of the oscillator from the mixer grid, and using a line folded into the cabinet. The first model will be for 10 and 5, while another for 2½, 5 and possibly 10 will be forth-coming.

W5TW in Hugo, Oklahoma, tried feeding both a horizontal and a vertical beam on ten meters, with the result that W6 contacts were continued into the dark, when the signal would be out on a horizontal flat-top beam and fading on a vertical.

On Easter, March 24, W1LKM noticed that "ten" opened up at night for short skip operations to W2-3-8-9. The report of W9ARN has already been commented upon in detail above.

W1LEA in Lawrence sends in some pictures of his layout. The 10-20-40 meter rig ends in 35T's with 500 watts input, working into a 33-foot antenna. A separate pair of 35T's are on 2½.

According to G2YL, there was not very much to be heard in England during February, but the 11th to the 21st was the best period. OQ5AE was logged on February 11, 20 and 26, with plenty of W's calling him on these and other of the fifteen days on which they came through. A solitary W6 was logged. PY1HP was audible nearly every day, and South American signals were improved over the previous month, being logged on fifteen days after the 9th. European calls heard included UE3YW UK3AH D4BUF HA3UH LX1UU LX2OK ZZ1A.

March conditions in England were similar except that western W's were more frequently heard, and a record number of South Americans were heard, thanks entirely to the dx contest. March 16 was best, otherwise the first week was



On the left, W9ZJB of Kansas City; on the right, W9USI, Brookings, S. D.

best. March 8 to 13 was poor except for a few southern stations. The storm on March 24 obliterated the finish of the contest and caused a wipeout for several days. K6JPD was the first oceanic station of the year. OQ5IM is a new one heard four times. Unusual South American stations, mostly during the contest, were CE3BI CE3CO CX1AO CX1FB CX2CO HK4DK OA4L OA4U, and others reported were CE2BX HC1JB HCIJT YV1AQ, thirteen each LU and PY. W7ACD was outstanding. A casual listener on March 16, 17 or 23 would have been amazed at the sudden increase in c.w.—more than in the whole of the previous six months. W's were heard calling TF1L, possibly in Iceland.

On a dead ten-meter band just before noon, W6QLZ has worked W6PNO near Los Angeles, 250 miles away, both pointing their beams at Australia. Also, he has been hooking W6PQQ, 100 miles away, in the evenings with both pointing their beams south.

56 MEGACYCLES

W8PK near Rochester heard W8QDU in Detroit during the February 11 relay, but missed the March aurora dx during the ionosphere and magnetic storms that have been occurring. W9ZJB says that the band was open 2½ hours on February 14, but his rig blew up. He heard a Camden, N. J., station and some marathon talkers in Atlanta. W3BYF worked W8QDU during the aurora of February 24. W1IZY had to point his beam north that day for his contact with QDU.

During an aurora on March 8, W8OKC in central Pennsylvania heard two weak signals from low locations 60 and 85 miles away, despite a poor receiver and antenna as yet. One of his new acorn tubes arrived with a short between control grid and cathode, but it was sent back for a replacement before being put in the new concentric-line-tuned superhet. The pipes are three-inch cylindrical copper rainspout, thirty inches long, to be loaded up for ten and shorted part way down for 2½.

That Easter Event

The report of W9ARN was only one of many for March 24. In Cuyahoga Falls, near Cleveland, W8LKD heard garbled and fluttery signals sounding more like i.c.w. than c.w. when he got on the band at 7:45 p.m. Eastern time. He heard W1KJT W2AMJ W3DBC W8TIU W9GGU or GGS (GGH?) and worked W1LLL BJE W3BZJ W9ARN. Some doubtful ones were W2KEF DI CUD. W2AMJ called him, but at the wrong time. Phone, and i.c.w. without a keyed carrier, were unintelligible.

Near Chicago, W9VHG heard W3DBC EIS W8CIR TIU on c.w. with the beam north, starting at 7 p.m. Central time. Like W8CIR, he heard nothing above 57 Mc. and worked nobody. W9GGH in Kenosha raised CIR and others. W9QHZ in Glen Ellyn also heard some dx.

W8VO in Akron heard about the magnetic storm about 4 p.m. and checked his receiver. The high audio frequency noise on 56 Mc. was about 10 or 12 db above normal background, of fairly constant amplitude, and around 15,000 cycles. Another frequency around 2 to 5 cycles was just under the noise level. Around 5 p.m., the major noise began to subside and signals took shape. W2AMJ was very broad. W2KLZ W3DBC were picked out, sounding like a hiss, on which the beat oscillator had no effect. The c.w. stations could be identified whereas the i.c.w. and phone signals generally could not. At 8 p.m., W2AMJ was 500 kc. wide while 8CIR was spread over nearly a megacycle. After that, normal characteristics were resumed though CIR's c.w. sounded like the drone of an airplane motor.

W1CLH raised W3DBC for a new state.

W1CLH raised W3DBC for a new state.
W3BYF in Allentown worked W1VC IZY
W3DBC W8CLS WCIR and heard W1HXP BJE
KJT W8NYD, all of whom were using c.w.

KJT W8NYD, all of whom were using c.w. At Saginaw, W8TIU started the dx off by hearing W8CIR at 7:58 p.m. Eastern time, continuing through a contact with the same station at 1:14 a.m. and going out at 2:30. He worked W8VO LZN CIR W9ARN and heard W2AMJ DBC (W3?) W3BZJ W8NYD LKD. He got both sides of c.w. contacts between W2AMJ W8LZN and W3BZJ W8LKD.

Bert Fageol, W8NYD, was on in Kent, Ohio, for the hour before midnight, extended H antenna pointed north, receiver starting with a 954 acorn preselector in front of his DM 36. He worked W3BZJ and heard W1LLL HDQ DEI W2KLZ JCY AMJ LAH W3DBC RL. That's the longest list and in only one hour—we wonder how much it is due to the coaxial tank and acorn



STABILITY in the "HQ-120-X" was obtained, first, by a voltage regulator for the high frequency oscillator so that even considerable changes in line voltage have no appreciable effect on the oscillator frequency—the oscillator doesn't see-saw back and forth during unsteady line conditions. Second, the "HQ-120-X" has drift correction which takes care of oscillator changes due to temperature rise.

The usual warm-up period has been reduced to a matter of minutes. Mechanical construction probably has the greatest bearing on stability. In the "HQ-120-X" special attention was paid to design of the tuning condenser and coil rack so as to practically eliminate the possibility of twist during temperature changes. If you are looking for high class performance at a moderate price-try the "HQ."

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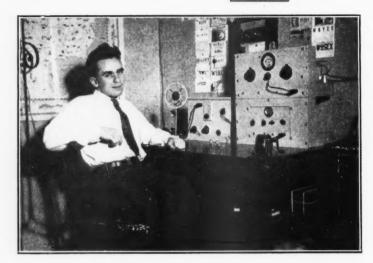
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W1JFF, Fred Evans, Newport, R. I.

tube. He gives us the only report for the evening of March 25 when at 8 p.m. he logged W2KLZ and W3DBC, with flutter. He ends with, "Tel the boys to use c.w."

Later Ionosphere Storms

On March 27, W6QLZ heard harmonics from Bolinas, California, up to 50 megacycles between 7 and 9 p.m. On the 29th, W9ZJB could hear things only with the beam pointed north, from 7:45 to 10 p.m., with r.a.c. on all carriers. The only one identified was W8VO using c.w. and a bug key. He heard two W9's and was reported by W5FYF in Oklahoma City but did not make a contact for that much-needed state. W9USI in South Dakota saw the aurora and heard signals in the same period as ZJB. In the early part, signals came in and out quickly-had they been on c.w. it would have been duck soup to copy them, he says. At ten p.m. he heard W9DWU in Minneapolis calling W9ARN on c.w. Then he worked W9ZHB in Zearing, Illinois, who came through on phone although USI stayed on c.w.

W8TIU opened up on March 29 hearing W8CIR working someone at 8:10 p.m. Eastern time. He says, "There were very many modulated carriers, none of which was readable. There was a marked absence of c.w. . . . why???" He raised W9UDO of Union, Illinois, at 9:52 when UDO was the best on the band. W8RKE was also contacted. Those heard were W1PLI W2AMJ W3RL BZJ W8CIR QDU VO W9ZHB. He contacted. thought W1PLI replied but another call was fruitless. W9UDO worked W8QDU, both ends coming in at TIU.

W3BYF worked W1HDO W2KLZ W3RL and heard W1LLL W8LKD, two of them after midnight which makes it March 30. From 10:15 p.m. on April 2 until 1:15 a.m. on the 3d, BYF worked W1IZY LLL W3FJ W8CIR PKJ PK and heard W1KXE FJN W3DBC. Although all used c.w., he could copy W3DBC and W8CIR on phone too, this time. That brought him up to eight states in 1940 but he hasn't indicated total states worked so far, for our Honor Roll.

At Midnight April 2, W8PK rushed home by the light of the aurora, getting the receiver warmed up by 1 a.m. on the 3d. The first twist of the dial brought signals. The first call, to W3BYF, was good, and a switch to W3BZJ brought another contact with an S8 signal. When BZJ signed, W1LLL was calling PK, weaker but steady. All of these were on c.w. and all were short contacts. He closed with a local, W8PKJ, who had heard and worked several W1-2-3-8 stations since 10:30.

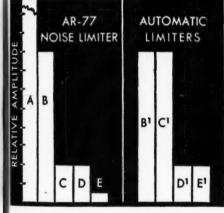
Extended Ground Wave DX

For several months, W8PK QDU have been trying weekly cross-band schedules on 5 and 75. PK has heard QDU several times when the band was apparently not open (Detroit to Rochester, N. Y., is about 300 miles). W8PKJ is joining the schedule too. On March 26, QDU came through on five better than PK did in the 75 meter ORM.

W9ARN says that ZHB in Zearing, Illinois, started to work HAQ in Davenport afternoons in March, definitely extending the Illinois net out to lowa. HAQ has a couple of hundred watts. ARN also heard W9TFY at Alpha, about 30 miles south of Davenport. TFY has 250 watts. ARN has also raised W9KZD at Ashland near Springfield who uses an 807 final run from a farm light plant. ZHB has a contact with VHG, northwest of Chicago, once in a while. During the February relay, ARN heard W9ZUL and VHG, about 150 miles or more.

April 1 brought quite a little pre-skip dx. W8QDU said that conditions were about as favorable as he had seen them. W9SQE reported W9PQH ZHB CLH W8CVQ. VHG worked CVQ but CLH was having trouble (antennas dif-[Continued on Page 77]

Signals..successfully received through "S-4" ignition noise!



A-Noise Peak Amplitude at Second Detector

B-Average Noise Amplitude at Second Detector

C-Suppressed Noise Peak (AR-77)

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D-Signal Amplitude (100% Mod.) at Second Detector

E-Average Noise Amplitude after Suppression

B!-Average Noise Amplitude ("Automatic" limiter
circuits)

C1-Suppressed Noise Peak ("Automatic" limiter

D1-Signal Amplitude (100% Mod.) at Second Detector E1-Average Noise Amplitude after Suppression AR-77

COMMUNICATION RECEIVER

Not overlooking its unmatched stability* and truly amazing signal-to-noise ratio**, the new manually-adjusted noise limiter of the AR-77 has probably attracted more favorable attention than any other single feature. And no wonder! Under actual operating conditions in the 10-meter band, "S-1" 'phone signals have been successfully received where ignition noise was pounding away to the tune of an "S-4" reading on the carrier level meter!

The circuit is extremely effective in that peak noise voltage hundreds of times higher than the signal is pulled down to signal level. Since these peak noise impulses occur intermittently, the remaining "effective" noise can appear below the signal level! Weak signals are not smothered because any variation of noise level will not alter the amount of suppression.

Write today for complete, descriptive folder—but, above all, visit your nearest RCA distributor and give the AR-77 a whirl. You be the judge!

*Tests under average conditions show max, drift at 30 Mc to be only 3.0 KC on one bour run, thereby keeping the signal audible. **A 2-to-1 ratio of signal-to-noise is obtained at an average sensitivity of 2 microvolts throughout range.

Net price, \$139.50 f. o. b. factory. 8" Speaker in matched cabinet, \$8.00

RCA MANUFACTURING COMPANY, INC., CAMDEN, N.J. + A Service of the Radio Corporation of America

What's New . . .

IN RADIO

ADJUSTABLE LINK 50-WATT COILS

A new series of "airwound" adjustable-link oscillator and buffer coils has recently been announced by Bud Radio, Inc. of Cleveland, Ohio.



These coils are designed for use in circuits where it is desirable to adjust excitation or antenna loading by varying the link coupling.

Each coil is individually linked, and coupling is varied by pushing the link in or out of the main winding. In view of the fact that each coil has its own

link, the coupling adjustment for each band can be left permanently set at the proper value.

All coils in this series fit standard 5-prong sockets and are designed for operation in stages where the input power does not exceed 50 watts. Coils are available for all amateur bands.

NEW MIDGET ELECTROLYTICS

For applications calling for very high capacity values at very low voltages, seven popular values and voltage ratings are now offered in the midget metal-can electrolytics by Aerovox Corporation of New Bedford, Mass. The capacities range from 1000 to 3000 ufd., with working voltages of 6, 12 and 15 d.c. The metal can is fully protected and insulated by the paper sleeve extending for the full length and rolled over the can edges,



to preclude shorting of leads on the can. Units are supplied with mounting straps, except for a larger can size unit which has a standard mounting ring.

NEW RME-99 RECEIVER

The Radio Mfg. Engineers, Peoria, Illinois, have recently announced a new receiver which has a number of features which make it an out-

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standing communications set. Covering from 540 to 33,000 k.c. in six bands, the receiver has full calibrated bandspread on the 3.5, 7, 14 and 28 Mc. amateur bands. An illuminated R meter is calibrated in both decibels and R units.

Employing 12 tubes, including rectifier and voltage regulator, the receiver incorporates low loss loctal tubes in the r.f. and amplifier circuits. A special bandswitching system permits a high L/C ratio on all bands, and use of a wide-spaced, exceptionally rugged tuning condenser along with a cast aluminum chassis results in high stability even on the highest frequency band.

On the lower frequency bands, the r.f. coils are permeability tuned and have unusually high Q, due to use of iron cores. Low temperature drift is obtained on all bands as a result of careful design and quality components.

A new type crystal filter permits six degrees of i.f. selectivity and controlled phasing. The beat oscillator has a pitch control on the front panel. A highly effective noise silencer is incorporated, with panel adjustment for obtaining maximum silencing action at various degrees of modulation with a minimum of distortion.

Terminals are provided for break-in operation, as is a built-in relay control circuit for an external relay. The undistorted output is 4 watts at both 4000 and 600 ohms. The entire receiver is thoroughly weatherproofed for operation under the most adverse climatic conditions.

[Continued on Page 91]



A New and Complete Solution to the Problem of Mobile Operation on Either the Amateur or Police High Frequency Bands — the 30M Stancor Transmitter Kit.

- 30 watts amplifier plate input— 100% modulated.
- Operating range, 28 to 40 MC.
- Only four quick heating, low drain tubes—no delay in operation.
- Press-to-talk operation—controlled at microphone handset.
- Low battery drain—40 amperes at 6 volts under full operating load.
- Chassis will accommodate either dynamotor or vibrator power supply.
- Rugged design—to stand up under severe mechanical abuse.
- Mechanically and electrically stable.
- · Locking rings on tubes and crystal.

- Antenna change-over relay switch.
- Easily installed; requires connections only to battery, microphone and antenna.
- Complete metering provided by selector switch and either self-contained or plug-in meter.
- Servicing and operating breakdowns reduced to a minimum through the use of heavy duty components.
- Easily assembled and wired with Stancor's exclusive "POINT TO POINT" instructions.
- Size—14½" x 10" x 8" overall— Weight, complete, 39 lbs.

This unit may be purchased in kit form, less accessories (tubes, crystal, meter and power supply, etc.), \$41.00 for approximately

ASK YOUR STANCOR DISTRIBUTOR FOR BULLETIN NO. 191-A, COMPLETELY DESCRIBING THE STANCOR 30M TRANSMITTER KIT, ACCESSORIES REQUIRED, CIRCUIT, ETC.



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STANDARD TRANSFORMER

· CORPORATION ·

1500 NORTH HALSTED STREET . . . CHICAGO

VARION of the MONTH

THE BIRTH OF A BROADCAST RECEIVER

Tremendous ingenuity and research go into the design of a modern b.c. receiver, a fact which the average ham usually fails to appreciate. The author, a former employee of a radio factory, realizes that the exact method of production varies in different factories; but this account is typical:

Several dozen stern-faced men are grouped around a long table. At the head of the group is the president of the company and on each side of the table are lesser executives and department managers. Next, the engineers are seated in order of rank, the 27th assistant engineer sitting at the foot.

It is of course first necessary to design the new receiver and, at a signal from the president, everyone feverishly scribbles on a pad of paper in front of him. Those present must draw a diagram of the part of a radio circuit which most appeals to them. While one man may draw a detector circuit, his neighbor may draw an oscillator, and so on. Since there are so many employees present there are bound to be several circuits of each stage.

Upon finishing his circuit each member drops it into a bowler hat which is passed around. They are shaken up and each man selects one, shouting out what he has drawn. As the receiver design approaches completion the excitement becomes intense. Finally, only one stage is missing and all eyes are eagerly turned upon the man whose trembling fingers are reaching for a slip of

He glances at what he has drawn and shouts "Bingo!" if he drew the needed stage, revealing to the group that the design has been completed. Of course it may happen that three or four detectors are drawn before someone gets an oscillator. In this case the radio set is advertised as possessing "unique features never before found in any radio!"

After the design has been decided upon it is necessary to see if there are any restrictions governing its production. The Amalgamated Brotherhood of Radio Engineers and Bee Hive Architects held a conference in 1936 and introduced very strict production regulations which are observed by all ethical manufacturers. For example, Section 2, Rule 49, Paragraph 54 states that no five-tube receiver shall be built on a chassis bigger than 2½ by 5 inches. Another ruling to be found under Subsection 7 states that no resistor whose dissipation rating exceeds half a watt may be used in a four-tube set.

Considerable time is spent checking these regulations and in the meantime a conversation something like this takes place:

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tion something like this takes place:

President: "I find that we still have two thousand 201A's on hand. I move that we use them in this receiver as a half-wave rectifier."

First Engineer: "We could make the power transformer smaller by drilling holes in the top of the cabinet to let the heat out."

Nineteenth Assistant Engineer: "An excellent idea! But wouldn't the customer be suspicious at the sight of the holes?"

Head Salesman: "Not if we tell him that they improve tonal qualities, increase distant reception and cut down static."

reception and cut down static."

First Engineer: "Sure, tell 'em it's to let r.f. in."

President: "Here's a note from the Jalope Motor Car Company. They can give us a good buy in twenty-five thousand clutch pedals that were made a little too small. Do you think we can use them?"

you think we can use them?"
Fourth Engineer: "We might work them into a bandchange switch."

Eleventh Vice-President in charge of wrapping and sweeping out: "Good! We can advertise something like this: 'You use your feet to operate your car—why not your radio?' Sensational! Different!"



THIS IS A PHOTO OF HALLICRAFTER SETS CARRIED IN STOCK

Write me about type of receiver you want. I will help you get the right receiver and will cooperate with you to see that you are 100% satisfied. Ask for technical information about any receivers.

YOU get ten days free trial — you don't buy unless you are satisfied.

YOU buy on 6% terms financed by myself with less cost — more convenience — quicker delivery. Transaction is entirely between us. Write for terms.

YOU get big trade-in for your receiver — describe it and I will tell you its value — you can pay the balance on my 6% terms. Don't trade until you get my offer.

YOU get prompt shipment from the world's most complete stock of amateur receivers. Or shipment from the factory if you wish.

I have a complete stock of all receivers, transmitters, kits, antennas, tubes, parts. Send to me tor any equipment. I guarantee you can't buy for less or on better terms elsewhere. Your inquiries and orders invited.

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In due course all red tape is ironed out and a working model is built. Naturally the feat of getting so much into such a small space calls for professional attention. The record in this respect is held by Mr. Cedric Throttlebottom, who, early in 1937, managed to get eleven resistors, six fixed condensers and two coils into two cubic inches of space. Mr. Throttlebottom unfortunately became mentally deranged after this achievement, and now is confined in a mental institution.

When the working model is finished it is tested by a committee of six who are most critical with respect to its operation. Even in the cheaper receivers it is seldom that more than six oscillations or "birdies" are permitted to appear across any one band. The aligning, too, is accurately checked and if the set is out more than twenty or thirty kilocycles it is immediately rejected.

Test sentences are broadcast, also. Unless four of the six on the committee can understand most of what is being said the set is not sold as a high fidelity model.

In view of the above information it is to be hoped that amateurs will look upon b.c.l. sets with a more tolerant eye and not be so quick to speak unkindly of them.





The Amateur Newcomer [Continued from Page 58]

It is only natural that the reader should wonder as to how reradiating objects may be detected; this may be done quite effectively by first suspecting everything and secondly by approaching individual objects (keeping the transmitting antenna in back of you) with a field strength meter and observing whether there is any increase in the reading as the distance from the transmitting antenna is increased and the distance to the suspected object reduced. Lastly, all b.c.l. antennas should be taken down individually for a temporary check as to their contribution to the general field strength around the building. Once this is done, and providing the transmitting antenna is properly adjusted, b.c.l. interference should be absent or at least reduced to the point where a wave trap will be effective.

BIGGER AND BETTER THAN EVER

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BICCER AND BETTER THAN EVER

It would be advisable for amateurs operating on frequencies lower than 7 megacycles to consider their antenna system in the event of b.c.l. interference, for even on these lower frequencies a high field strength in the vicinity of a b.c.l. receiver will produce undesirable effects. A wave trap will be of very little effects. A wave trap will be of very little effects in removing the unwanted signal from the b.c.l. receiver if the field strength around the receiver is sufficient to be picked up by an audio tube.

According to the sales reports of leading b.c.l. receiver manufacturers, table model sets far outsell all other models. A typical, leading b.c.l. receiver manufacturer makes no table models with an r.f. stage, and none of their consoles costing under \$100.00 have preselection adequate to reject 160-meter-band images. Since b.c.l. receivers are so susceptible to interference from amateur transmitters, it should be worth while to minimize the field strength in the vicinity of the transmitting antenna in accordance with the following:

 Erect the transmitting antenna as much in the clear as is possible.

2. Check the feed system for standing waves and unbalance. Adjust if necessary.

3. Where possible use an antenna providing some gain, either unidirectional or bidirectional. The use of such arrays seems to minimize the blanketing or "shock" effect.

4. Operate on the exact frequency the antenna and feed system are cut for.

Avoid tuned feeders having high voltage at the transmitter end (use untuned feeders if at all possible).

Properly defined completely, *electricity* is a property, a quantity, and a science.

640 PAGES — 640 PAGES — 640 PAGES — 640 PAGES — 640 PAGES

TOPS!



The 640 page, 1940 Radio Handbook has been acclaimed the world over as the outstanding text of Amateur, Shortwave and Experimental radio.

Complete and easy-to-understand chapters on: Introduction to Amateur Radio; Introductory Electricity and Fundamental Radio Theory; Vacuum Tube Theory; Radio Receiver Theory; Receiver Tube Characteristics; Radio Receiver Construction; Transmitter Theory; Radiotelephony Theory; Transmitter Tubes; Transmitter Design; Exciters and Low-Powered Transmitters; Medium and High-Powered Amplifiers; Speech and Modulation Equipment; Power Supplies; Transmitter Construction; U. H. F. and Mobile Communication; Antennas; Test and Measurement Equipment; Workshop Practice; Radio Therapy: Radio Mathematics and Calculations; Radio Laws and Regulations; Etc.

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Wide Range Audio Oscillator

[Continued from Page 22]

absurdly simple once the 'scope and the oscillator are in front of the operator. The procedure, though simple, must be followed exactly as given in order that no error be introduced, since any error introduced at the outset would be cumulative throughout the calibration.

First, it is best to have both the phones and the vertical plates of the oscilloscope (through the amplifier in the 'scope) connected across the output of the oscillator. Then with alternating current directly from the line fed into the horizontal plates of the 'scope adjust the frequency of the oscillator on the

lowest range until a figure such as is shown in figure 4A is obtained. This figure indicates that the vertical deflection frequency is exactly twice that of the horizontal deflection frequency. If your local line frequency is 50 cycles the audio oscillator is putting out at exactly 100 cycles; if it is 60 cycles the oscillator is on 120 cycles. We will assume that the local line frequency is 60 cycles, since that is the line frequency in most places.

Turn the synchronization control until there is no interlocking between the incoming signal and the sweep oscillator, turn on the sweep oscillator, and adjust its frequency until a single stationary sine wave appears on the screen. The sweep oscillator is now on exactly 120 cycles. We have thus transferred our standard of frequency from the 60-cycle line to the 120-cycle linear sweep oscillator. Make up a chart of calibration frequencies against switch positions and dial settings. Make this the first calibration point: 120 cycles, range 1, dial 52 (or whatever it happens to be in your particular unit).

Lissajou's Figures

The determination of the calibration points for frequencies intermediate (fractional multiples) between the fundamental and integral harmonics, such as the second, third, etc., can be determined through a knowledge of certain geometrical patterns which will be seen on the screen of the oscilloscope, called Lissajou's figures. Their interpretation is simple enough since they represent, when standing still, fractional relations between the two frequencies which are being impressed upon the vertical and horizontal plates of the oscilloscope.

The fractional relation between the two frequencies can be determined by a simple inspection of the waveform which appears on the 'scope. First, the number of complete bumps which appear along the top in the horizontal direction is counted—this is the numerator of the fraction. Then the number of traces is counted (this may be determined by counting the number of free "tails" at either end of the figure, or by taking one more than the number of crossovers on any ascension or descension of one half of one of the sine waves) and this value is the denominator of the fraction which represents the relation between the frequency on the vertical plates with respect to the frequency of horizontal sweep.

Figure 4B shows a Lissajou's figure which represents a 4/3 ratio between the impressed voltage and the horizontal sweep frequency. If the sweep frequency were still 120 cycles in this case, the input frequency would be 160 cycles. Calibration points for frequencies which are intermediate between integral multiples may be obtained in this way.

Prong-Base Midget ELECTROLYTICS

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While achieve compactness and AEROVOX So base midgets dard AER

Yur darn tootin'—these jobs may all look alike but there can be a heap of difference beneath the label, can, base.

While achieving reasonable compactness and low price, AEROVOX Series F prongbase midgets contain a standard AEROVOX dry electrolytic section with approximately twice the foil area for given capacity and voltage, to insure long, dependable life. Nothing vital subtracted to meet any size or price.

A nice choice of popular working voltages and capacities to meet your needs.

Ask for CATALOG

Unit above is shown actual size. 450-450-25 v., 10-10-25 mfds.

Negative grounded can, Choice of metal or bakelite mounting washer.

Choice of 1 x 2 and 1 x 3 inch dual and triple section units, in various working voltages More pages, more items, more choice—the latest Catalog is the best yet. Ask local jobber for copy—or write us direct. And ask your jobber to show you any AEROVOX condenser you may need.



Integral Multiple Calibration

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Now switch to the next higher frequency range and, keeping the *sweep* oscillator on 120 cycles, set the dial of the audio oscillator to the point where two complete sine waves appear on the screen. The oscillator will now be on 2/1 times 120 cycles or 240 cycles. Put this down in the chart and increase frequency until three sine waves appear: this will be 3/1 or 360 cycles. Next comes four sine waves or 480 cycles (the figure for this is shown in 4C), five sine waves or 600 cycles, six sine waves or 720 cycles, and 7 sine waves or 840 cycles.

Since it becomes difficult to count the number of waves accurately with a small c.r. tube, we must increase our standard frequency to enable the calibration of the higher ranges. This is a very interesting and comparatively simple procedure, but it must be followed carefully, step by step. First, the oscillator is tuned down in frequency again until there are five sine waves on the screen indicating 600 cycles. It is important in making all these adjustments to tune the oscillator carefully until the pattern stands quite still. Now retune the sweep oscillator in the oscilloscope until there are six sine waves on the screen where there were five before. The sweep is now on 100 cycles instead of 120-hence the six waves instead of the five. Now retune the audio oscillator until there are five waves on the screen instead of six, the oscillator now being on 500 cycles, and then retune the sweep oscillator until there is only one sine wave on the screen. This puts the sweep oscillator on 500 cycles, our new base frequency.

Now by switching the oscillator to the third range the frequencies of 500, 1000, 1500 and 2000 cycles may be checked by their one, two, three, and four sine-wave patterns. Then the audio oscillator may be shifted to 1000 cycles, the sweep oscillator shifted to 1000 cycles to give a single wave, and the frequencies on the next range from 2000 to 9000

cycles checked.

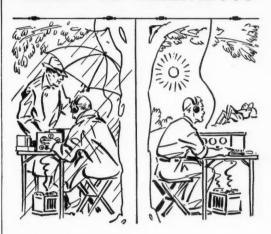
For extremely high audio frequencies the oscillator may be shifted to either 4000 or 5000 cycles and the sweep oscillator increased in frequency until a single sine wave is visible showing that the sweep is on the same frequency. Then this frequency may be multiplied on up in the manner used for the lower frequencies until calibration up to 20,000 cycles or above is obtained.

As a check upon the entire calibration the entire process may be reversed and the difference between the resulting check line frequency and the actual frequency determined. If it is very far off the whole process had better be repeated in order to obtain a more

accurate calibration.

See Buyer's Guide, page 98, for parts list.

RAIN or SHINE...



MALLORY Vibrapacks

are always dependable

Every day is Field Day for countless Mallory Vibrapacks. In 24-hour-a-day regular operation, these Vibrapacks provide unfailing service in police squad cars, in forest fire control stations, in airplane communication equipment, in ship-to-shore telephone and in other similar services from fixed stations and in mobile equipment aboard automobiles, boats and airplanes. The selection of Mallory Vibrapacks for these applications is logical because of their dependability, lower battery drain and economy.

Amateurs want these same advantages for their Field Day and QRR rigs—especially when genuine Mallory Vibrapacks cost no more than other forms of power conversion equipment. Learn the advantages of Mallory Vibrapacks and why they provide "Perfect Portable Power" for receivers, transmitters and P.A. Systems. Ask your distributor for the technical data booklet, form E-555-C, or write—

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Bamboo Radiator Elements

By "CHUCK" MURRAY, W9NWU

Bamboo poles are very strong and also very light, and if they are covered with a thin metal film, they make excellent self-supporting radiator elements. Since, at radio frequencies, all of the r.f. current travels on the surface of the conductor, the metal film to be applied to the poles can be very thin. Lead foil (com-monly called "tin foil") or aluminum foil will make a very satisfactory conducting surface for bamboo pole radiators. The cheapest and probably the best source for obtaining the aluminum or tin foil is the old junk box. A one-ufd. paper condenser has two pieces of foil over 16 feet in length, which will make two 20-meter quarter-wave sections with no break in the length of their metal films. If the two pieces of foil are separated with an equal number of sheets of the wax paper dielectric for a backing, the foil can be handled much easier than if it is used alone. This is especially true of "tin foil," which is very fragile.

* 3217 Gaylord St., Denver, Colo.



The type of bamboo poles to be covered will depend upon the source of poles in each particular case. The poles used by the author were 16-foot fishing poles, which were one inch in diameter at the large end, and tapered to ½ inch at the small end. In spite of the diameter of the small end, these poles were found to be extremely stable, even when covered with several inches of heavy snow and ice, and they are electrically efficient.

It is necessary before applying the foil to remove the knots from the poles. A heavy rasp or very rough sandpaper will take off these high spots in a hurry and leave the poles in good shape to be covered. To cover a pole, a single length of foil is laid out in an open space and smoothed over its length, with the foil facing upward. The smoothed bamboo pole is laid on the strip lengthwise, and using a little melted paraffin the foil and its paper backing are stuck to the pole, rolling the foil and paper around the pole. There may be an objection to the use of the wax paper with the foil, since it will not allow the formation of a perfect metal tube, but experience shows that this is not important, and the use of the paper with the foil adds to its strength and protects it while the pole is under construction. Actually, the bamboo pole acts as the support of a 16-foot (quarter wave) length of foil, whose large area gives a high Q.

Another protective covering is now applied so that the foil and the bamboo pole will withstand the elements. Cheesecloth or muslin cut into two-inch strips, and used as tape, is now wrapped tightly around the pole. After the pole is completely taped, it is painted with melted paraffin to hold the cloth in place and to weatherproof it. A pair of 16-foot poles uses one pound of paraffin, and 1½ yards of cheesecloth or muslin.

To make connections at the end of a quarter-wave section a portion of the wax paper and tape wrapping are omitted over a length of about two inches, leaving the foil exposed. A clamp type connection is made using a thin sheet metal strip 2 inches wide as the clamp. A direct soldered connection cannot be made, because if tin foil is used it will melt upon application of heat, and if aluminum foil is used, a lead type solder cannot be used to make a connection.

These fabricated elements are inexpensive, lightweight, and very strong, and are suitable for the construction of rotating beam antenna systems or they make excellent, high Q, half-wave antennas which are easy to mount on a single ladder type structure.

U. H. F.

[Continued from Page 66]

fer in polarization). W9AQQ in Indianapolis worked ZHB around this time, but the distance is beyond the usual ground wave work for the Illinois gang and it may have been on an aurora night. It will be interesting to find out more about it.

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With 500 watts on HK54's, W9ZJB in Kansas City has jumped up his signal to W9VWU in Topeka, and fading has become nil. VWU lost his beam in an 82 mile wind, so the circuit is now one-way using only a doublet.

Miscellany

George Readio, who got the call 1AZ when H. P. Maxim got 1AW and Tuska was also in the RI's office, has been handed W1AZ back after being W1KEE for a while. He is on 5 and 75 with 300 watts into 35T's, modulated by RCA 811's with AMC. Before the first world war, George also held the call 1ON and used 1ZS on 425 meters.

In Bridgeport (that's in Conn., you know), W1CLH is still banging away on 56,304 weekdays at 11:30 p.m. Things were picking up by early April so that at least a few stations were still on around midnight. The beam is ready for the rotating gear.

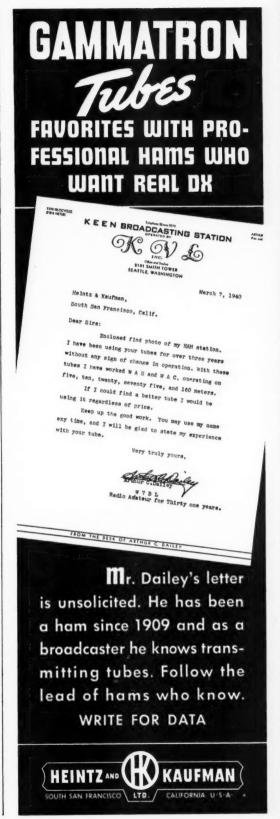
Over at Newport, R. I., W1JFF says that his five-meter rig starts with a 6J5-G ten-meter crystal stage, 6A6 doubler, and 40 watts on a 6L6-G final. The ten-meter rig ends with 48 watts into an 809. The receiver has 1851 r.f., 6J8G mixer and 955 oscillator, all of which were on hand when Fred got the set-building urge. A Kraus twin-three beam à la November RADIO is used on ten, and a double section W8JK for five. Fred says that W1MMX will be on soon. He has spent many hours working W1JLK ZE FZU BJE JIS LPO HRZ BGA DJZ, especially late on Sunday nights. W1KLJ and HDQ come in like locals all the time. The Rhode Island and Mass. gang will welcome additions to the rag-chewing list.

W1LKM in Mansfield, Mass., has given up ten and is preparing to settle down on five with 150 watts on a 35T, and a hope for a 75-foot mast to clear power lines.

As receivers go, W3BYF has something different. The first r.f. stage is a concentric line tuned 954 acorn. This works into an 1852 second r.f. which is followed by a 6K8 mixer. The acorn stage increases the signals 2 R's but is at a disadvantage in stage gain when working into a low resistance 1852 input circuit. Noise level is high near BYF so set noise is well below it. The two stations that regularly come through are R9, and noise prevents accomplishing what he wants to do—to bring W3HOH in solid all the time. Pres says that the 954 coax, with only a $10-\mu\mu\text{fd}$ tuning condenser is more selective than anything he has ever seen. The antenna is coupled in with a U-shaped turn ten inches long, right against the inner pipe.

From the Southwest

W5TW in Hugo, Oklahoma, says that he has heard lots of W1-2-8-9 but never a W5. The band has been open a lot but not for his transmitter.



He is going to get out on five this summer, he says, if he has to put the signal in a bucket and carry it out. For a while he used the band to operate the transmitter 20 miles away and to modulate it. Ed is at a nice distance from Dallas and Fort Worth, so may be able to give W5AJG-EHM something to do on dead days. He is converting his 300-watt, ten-meter final for fivemeter operation.

Present five meter activity at W6QLZ near Phoenix is confined to nightly schedules with W6MVB at Squaw Peak. Both QLZ and W6KTJ put up lazy-H antennas for 2½ and 5 as described in RADIO for April, with fine results; QLZ is using one-inch copper pipe with 11/2-inch line; KTJ uses 7/16-inch aluminum elements. The antenna at 100 feet has a slightly greater gain than a four-element 1/4-wave spaced beam 50 feet high, and is not critical as to frequency, working well on 40 and 80 megacycles. With QLZ's transmitter on it, KTJ now needs no antenna on his DM36 for an R9 signal.

W8LKD in Ohio will move to Noblesville, 20 miles north of Indianapolis. He says that the gang works W8QDU CIR GGA. He is putting 217 watts on T55's, and is building up an organpipe pre-selector. He says that W8NYD and OPO have 954 acorn preselectors using two-inch copper pipes 281/2 inches long, as in the receiver described in RADIO last June. No doubt about it, the use of acorn tubes and coaxial line circuits is spreading, in one form or another. Your conductor has not tried them in preselectors, pre-ferring the simple life, no more complicated than an r.f. stage and mixer working directly into the More stages seem unnecessary, while preselectors involve the difficulty of coupling out of them into something else, without losing gain.

Help for the Relays

W8PK has been having cross-band 95-mile contacts with W8FYC, PK being on 160. He adds that W8DOD and TEX in Rochester are now on five, and W8AGU PKJ BCL SGX are too. W8DRW from Syracuse is about ready with 50 watts. Now get a station in Utica and the relays can work through New York, without making it necessary for W8CIR or someone else to work portable to jump the mountains in Pennsylvania. PK is taking facsimile signals from Buffalo, 73 miles away, on 43.7 Mc. One of the WHAM ops returned from Saranac where he found that Empire State television, about 250 miles away, was being received on Whiteface mountain at 5000

W8QDU says that W8JLQ near Toledo is working pre-skip dx now with a vertical antenna.

W8SCS in Benton Harbor, Michigan, is really starting at scratch this year, with a new pole, a concentric-line acorn receiver, and the whole works. He and W8CVQ have encouraged the Elkhart, Indiana, gang to get on five. SCS is a little closer to Chicago than CVQ is, so should make things more interesting for the Illinois

bunch. SCS has a pair of HK24's in his final now. W9ARN says that he and ZHB are usually on at 7 p.m. with W9RGH WOO GAO at Peoria. Illinois, W9BHT at Canton and W9CBJ at Washburn reporting in the net. W9DQH at Urbana is getting ready, and may help to bridge the gap to W9AQQ and W8LKD/9 around Indianapolis. W9UDO in Union, Illinois, promises that some five-meter stations in Rockford and Freeport will join the Illinois net soon.

One of the Milwaukee gang, W9IZQ, called here at Wheaton and brought the news. He does hear Chicago stations now and then, and W9CLH probably consistently. Perhaps it won't be hard to do some more Chicago-Milwaukee work after all.

A Yagi like that at W8CIR is going up at W9USI. W9AQQ and VEK ought to keep Indianapolis on the air, though it may take some organization for them to get a good range of distances to work within 150 miles or so. VEK mentions that some r.f. by-pass condensers in the Organ-pipe receiver described last June should be 50 μμfd., not .005 μfd. The object is to reduce the *inductance* in them, so that they can do some

by-passing at five meters.

Vince Dawson, W9ZJB, thinks that BNX should come on with a high powered c.w. rig. Yeah, but it is a long way back from 336 Mc. where your correspondent was generating a lot of a.c. hum lately. ZJB claims to have bet VWU five beers on the best dx for the summer. He is the guy that offered a case to the first station to work all districts on five meters—and had to drink it himself! He has put up a "W2AMJ Power-house Antenna" which seems to be an extended vertical double zepp. No reports yet on what the Wichita gang threw, when Vince made a convention speech in April.

W9YZX has moved from Wichita to Kansas City, where he is on with an HK24. W9HCL is on with HK24's and is working on a receiver.



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W9HIC of Independence, Missouri, has HK24's also and is building a converter. W9TOQ is getting back after a pause of two years. He and ZJB are putting coaxial lines into their new receivers. W9AHZ is back on the band too, and sends a message on five to ZJB for relay here by mail, to the effect that Bell Telephone is putting bells on their lines to be rung by sunspots. That is, when a magnetic storm develops 45 volts in phone lines, men are called off the poles. No mention is made whether these men can go home and work five-meter dx which is likely at the same time!

Above 112 Megacycles

Falor's suggestion of type 55 tubes for 50c looks good for low power transmitters. Recent 20% efficiency at W9BNX makes one wonder if large tubes and 125 watts are worth while if he can get more than half the power out of a single receiving tube and 400 volts. Ken says that the heavy loading of s.r. receivers is a result of adjusting them to oscillate too easily; if they won't oscillate until the plate voltage gets up to 35 or 40 volts, better results are possible. He objects to feeding the quench frequency into the control grid and drawing a lot of grid current. Except for strictly plate injection, the only other suggestion he made was the use of push-pull detection which he has found to be desirable. He likes a 3:1 ratio grid coaxial line 14 inches long, tuned with 15 µµfd. or less, and an 8-inch line with a 9:1 ratio for the cathode (and heater), similarly tuned, to provide an impedance to make the tube oscillate. His s.r. receivers use separate quench oscillators, of course.

W1LKM in Mansfield, Mass., has a receiver on 2½ and will be able to double down there when he works up some local activity. W1LEA in Lawrence has 200 watts on 35T's, having worked 16 stations out to about 45 miles. The antenna is a vertical doublet, the receiver an acorn 1-10.

Those Smith Transceivers

W5TW built up some of Smith's 2½ transceivers described in March Radio, and found them good up to at least 24 miles mobile! He has a higher powered job now, and 100 watts at the home station. Ed suggests using the chassis as part of a concentric line for the tuned circuit; he notices that one-tube jobs of this sort work best when the antenna is coupled to both sides of the tuned circuit so as not to upset the line balance.

W6QLZ is certainly all over the spectrum. Some six fellows in Phoenix are building transceivers. The junior college has four for field work and is testing with Clyde, who uses an HK24 with 60 to 105 watts input at 70% efficiency (sounds like xtal control). It works into another of those X-H arrays he has on five meters. W6KTJ has HY615's with 12 watts output. QLZ and KTJ hold nightly schedules using acorn s.r. receivers and long wire antennas. They are making up converters for the band but haven't been reported as buying any copper pipe yet.

On 224 Mc., QLZ adds filament chokes to his HK24 rig, getting out to W6MVB at Squaw



Suppose you want to change transmitter frequency—perhaps to dodge QRM. With the Bliley Vari-X sitting on your operating table, you just rotate the control knob on one of the two VF2 Wide-range Variable Crystal Units plugged into the panel sockets. If the first crystal should not take you where you want to go, you merely flip the selector switch to the second unit. And, of course, you can instantly plug in other VF2 Units which may be on

hand for allowing a greater operating frequency spread. See your Bliley Distributor for complete details on this full crystal controlled exciter ask him for descriptive circular D-2.

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Peak if he takes his receiver over there. Soon, KTI will have the HY615's down there to give him some company. QLZ says that his 1-160 meter rig with two finals is one better than W1HDQ. W8CVQ is getting results on 115 Mc. with

HK24's, working Grand Rapids and W8NZ in Battle Creek. Walter says that he is using a superhet receiver but will have to try "our" coaxial lines.

The Seiler brothers at W8PK had a 17-mile, 21/2-meter contact with W8AGU, using 110 watts into a crystal controlled W.E. 304-B. AGU used a 35 T doubler with 100 watts input. PK also got an R9 report with 20 watts input in an RK34, lines controlled. Rochester activity includes W8EBO and JPP using transceivers good for a mile or so.

W8QDU says that W8GU, on 11/4 using a stacked horizontal beam, found null points at 11-mile intervals. Bliley did not mention it but thinks that the work of the Erie gang is too sketchy to be of real value to anybody but themselves. At a new location, GU expects to do

some real u.h.f. work this summer. Detroit activity on 21/2 is reported as "quite pitiful," with a few stations on once in a while. With the advent of frequency modulation and the possibility of fellows like W8CVQ NYD VO CIR getting stabilized equipment, QDU thinks that there will be a mark to shoot at. He has a push-push doubler for 2½ and 1¼, and is investigating the pipe converter as a possibility for a sensitive receiver. QDU has been on fre-quency modulation, but only s.r. receivers are available so far to check it.

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RADIO

In Akron, W8VO gets on 112 with three hundred watts, his best dx being Canton, Ohio.

June 15-16 Field Days

Julia Morgan, W9LRT, is arranging a Chicago-Milwaukee private field day on 2½ for June 15 and 16. Plans call for putting the LRT rig at W9FXB, 200 feet up, with a six-element Yagi pointed at Milwaukee. Julia is still looking for other good locations for a test. W9GV may help to get the tower of the Edgewater Beach Hotel, a beautiful location about 300 feet up. W9GGH in Kenosha will have a 21/2-meter beam up soon and will be able to assist materially in the plan.

So far, most Chicago stations are using fifteen watts or less and the maximum distance is around 25 to 30 miles. Beams are almost unknown. About the only one not using 56's or 76's are W9BAN in Oak Park with T20's, TVT in Evanston with HK24's, and MQM in Evanston with a TW-75 doubler. Frequency modulation at MQM has not been so good, using ordinary s.r. receivers. Antenna coupling to these receivers has troubled many, proper adjustment making the difference between R9 and no signal at all. Tight coupling, high plate voltage, and bad radiation are the custom. LRT gets out better on 21/2 than on 5 with the same rig. Harmonics from lower frequency transmitters present quite a problem at times, due to the broadness of receivers. Aha, another candidate for coaxial line circuits.

W9SQE is now active in Chicago with T55's. He will alter his five-meter antenna for two-band operation, which should help him to get out on 21/2. A coaxial s.r. receiver is used mostly, inasmuch as signals drift too much for his concentric line superhet used on five. He works W9BAN in Oak Park but does not hear W9PNV in Riverside. W9VJO in Douglas Park is on too.

Dr. John Kraus, W8JK, very kindly arranged to call on W9SLG BNX on his return from giving some talks at the University at Ames, Iowa. Out of his suitcase he pulled a hinged squarecorner reflector and folded antenna for 50 centimeters. It used sides a wavelength long made of 0.6 wavelength wires spaced 0.1 wavelength. He promised a full 10 db gain compared with perhaps 7 db from a three element array, and no critical adjustments at all. He has tested larger units on 11/4 meters using a simple W.E. doorknob tube and two pipes as the tuned circuit.





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The folded antenna connects directly across the pipes, with no feed line. This square corner re-

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W1SS notes the 112-224 dx honor roll run two months ago and writes as follows about a contact reported in this column some time ago: While we do not agree with some of the articles as printed because of our close contact to what was taking place, we are not going to discredit anyone. So we are going to ask you to put on your honor roll the stations of W1BBM of Bernard Bates, North Harwich, Cope Cod, Mass., and W1SS of Art Stockellburg of Arlington, Mass. who have worked each other many times on 112 Mc., and still believe they hold the world's record of 81 miles for amateur station operation.' implication seems to be that the thing should be rechristened a liars' contest, which is quite o.k. by us, too. Only, let's make it good. The band is capable of the distances reported.

Out of Phase Excitation

After wishing you all good dx in June, the column is closed in a lighter vein with the following gem cribbed from the "literature":

There was a little daschund once So long he had no notion How long it took to notify His tail of his emotion And thus it was that while his eyes Were filled with woe and sadness His little tail kept wagging on Because of previous gladness.

Simplified Carrier Operated Remote Control

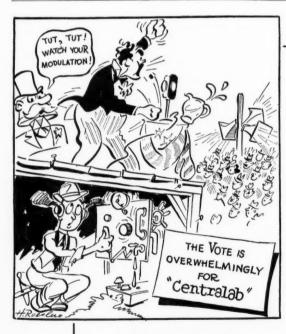
[Continued from Page 16]

band) can be accomplished by means of a motor-driven vernier condenser in a suitable electron-coupled oscillator. A s.p.s.t. relay in the anode circuit of V4 can serve to start and stop the motor. The motor speed should be geared down so that the tuning condenser in the v.f. oscillator can be stopped as the transmitter frequency reaches the desired spot (as checked on the station receiver or monitor). "Coasting" of the motor can be taken care of by means of a friction drag on the armature shaft. With a system of this type, one-half the frequency range covered by the vernier condenser in the e.c. oscillator must, of course, be limited to a value which corresponds to the permissible detuning of the other r.f. stages in the transmitter.

See Buyer's Guide, page 98, for parts list.

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Past, Present and Prophetic

[Continued from Page 6]

promised here last month. When the story was nearly completed, Dawley suddenly awoke to the fact that the 50-cycle a.c. upon which he was basing his description of the calibration was most handy for the purpose, but was only available in a few spots in the United States aside from southern California. Why we are honored with the convenient stuff in this part of the country, we don't quite know. The method of calibration he finally described in the article is suitable for either 50- or 60-cycle supply.

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De Luxe 112-Mc. Transceiver

[Continued from Page 30]

will be possible when the microphone is poled correctly. This switch permits the quick reversal of polarity that is required in order to make the difference easily detectable. When once correctly set, the switch may be left alone even when changing microphones, as single-button microphones do not generate their own voltage and hence have no inherent polarity so far as voice waveforms are con-cerned. The only way to reverse the polarity of the voice waveform in the microphone circuit is to reverse the polarity of the microphone battery with respect to the microphone winding. As the polarity of the microphone battery is fixed because of the fact that it is also used to supply bias, the reversal is accomplished by "flopping over" the leads to the microphone winding. Simply reversing the two leads to a carbon microphone will not reverse the polarity of the voice wave form in the speech amplifier.

One of the earlier versions of the transceiver took the mike voltage directly from the "hot A" through a filter choke, the latter being required to eliminate vibrator "hash." A 50-µfd. 25-volt electrolytic provided a return for the voice frequencies to ground. Bias for the 6J5 was obtained by means of a cathode resistor by-passed with a 10-µfd. electrolytic. The total cost of these components was just under \$2.00. In the final version these components were displaced by a single 1½-volt dry cell costing 30 cents, this battery furnishing both microphone current

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and C bias for the 6J5. Because a single-button microphone draws only 50 ma. or so at 1½ volts, and because the battery is good for at least 30 amp. hours, a battery such as this will last for at least 600 hours of transmission. There is no drain on the battery when S₁ is on receive or the microphone plug is pulled out of the jack. It is evident that under these conditions the battery will probably last longer than the transceiver.

No attempt should be made to use a small flashlight cell for the microphone. The internal resistance is sufficiently high that trouble may be experienced with feedback when the battery is also used for bias. When a standard dry cell is used, no such difficulty

will be experienced.

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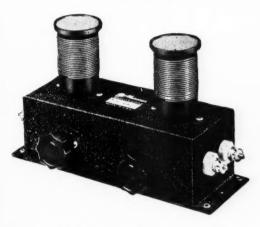
Thanks to the 6J5 speech amplifier, a singlebutton microphone will deliver more than enough gain even though the microphone voltage is quite low.

Construction

The rather strange and undeniably "haywire" arrangement of the unit illustrated is due to the fact that it was constructed with a dummy glove compartment panel as the front panel, in order to permit installation of the unit behind the instrument board, and also to the fact that the unit was changed or rebuilt at least a dozen times on the same chassis and front panel. Shorter tank leads to the HY-75 could be obtained if the HY-75 socket were lowered or the tuning condenser raised about an inch. However, as the tuning condenser was originally placed for an inverted 6J5GT, and as the socket could not be lowered any more than illustrated without its protruding too far below the line of the front panel and preventing the installation of the panel on the instrument board, it was decided to see what would happen if the leads were not as short as they should be. The high oscillator efficiency obtained indicates that nothing serious results from the comparatively long tank leads, though it undoubtedly would be advisable when constructing a unit from scratch to arrange the tuning condenser and oscillator socket for the shortest possible tank leads.

The exact layout of components is not particularly important so long as the r.f. leads are short and rigid. C₂ should be of the smallest available (physical) size, and the two r.f. chokes should have their leads cut off short on the "hot" end so there is just enough left to make a good soldered connection to the tank. The tuning condenser should be of the compact midget type which can be mounted by means of a bracket which bolts to the ceramic portion of the condenser. The shaft is sawed off as short as will still allow a ceramic insulated shaft coupling to be at-

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tached. Both sides of the condenser are "hot" to ground (both d.c. and r.f.). Be sure that the *rotor* of the condenser goes to the grid condenser, the stator to the plate.

It will be necessary to determine the exact number of coil turns by cut and try, as a very slight variation in turn spacing or in the diameter of the coil will throw the frequency out of the band by several megacycles. The exact number of turns also will be affected considerably by the particular physical arrangement of the r.f. components. For a starter, try 6 turns of no. 14 enameled, soldered directly to the lugs on the tuning condenser. Measuring the frequency by means of Lecher wires, the turns are squeezed in and out or a turn added or subtracted as necessary until the center of the band is hit at the center of the tuning knob.

Regardless of the type of antenna used, inductive coupling is to be preferred. One or two turns of solid, rubber-insulated no. 18 or 16 around the center of the tank coil will suffice for most any feed system. Intermediate values of coupling can be obtained by enlarging the turn or turns, or sliding them towards the grid end of the tank coil to cut down the coupling. For a given number of coupling turns, greatest coupling will be obtained when they are just slightly larger

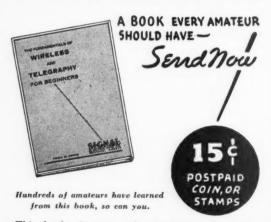
than the tank coil diameter and are placed around the center of the tank coil.

It is practically impossible to have really short tank leads if provision is to be made for removing the plate and grid clips. For this reason, the tube is inserted in the socket, clips placed on the grid and plate caps, and leads soldered directly to the clips. If the soldering is completed quickly there is no likelihood of the caps becoming loose, or the envelope glass cracking from the heat of the iron. No. 18 or 16 bare or enameled copper wire makes a much more efficient conductor than flexible braid, and if the clips are not to be removed there is no point in using braid. The wire should first be bent so that it will not be under tension when soldered at both ends. This will prevent the possibility of cracking of the envelope as a result of strain on the glass.

Operation

If the unit is to be used for actual mobile work, and not just while the car is parked, the antenna should be rigid. A length of 3/8 inch o.d. aluminum or dural tubing makes a good radiator, and will not vibrate or whip seriously when the car is in motion. A 2-foot length of such tubing, mounted on the sidecowl of the car by means of a feedthrough insulator at the bottom and a standoff insulator up about 3 inches from the bottom to steady it, makes about as good a radiator as does a longer rod or pipe, provided it is adjusted to exact resonance. This means that when excessive antenna coupling is used, a "dead spot" should appear at the exact center of the band. If it does not, the length of the radiator should be altered until it does. Then reduce the antenna coupling until the transceiver will just superregenerate over the entire band when the regeneration control is advanced full on. The bottom of the radiator is best fed with Amphenol low-loss concentric cable. If the line is quite short, the cheaper, rubber-insulated variety of concentric line may

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be used without excessive loss. The cable should not be over 36 ohms for best results.

A quarter-wave rod may also be fed with good results by means of a single wire feeder attached about ½3 of the way up from the bottom. In this case the bottom of the radiator is not insulated from the car chassis, but instead is bolted directly to it with a good electrical connection to the car body. The length of the radiator should be "trimmed" as mentioned above to get it to resonate at the exact center of the band.

While it is possible to get the antenna to load the oscillator when considerably off resonance simply by increasing the antenna coupling, much greater field strength is produced when the antenna is operated at exact

resonance.

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The "hot" 6-volt lead to the Vibrapack should be of no. 12 or larger wire and be no longer than absolutely necessary if a full 300 volts is to be obtained. The switch used to turn on the Vibrapack should be rated to stand 10 amps. A filter consisting of a 16-µfd. electrolytic either side of a low resistance 100-ma. choke is recommended.

When all through operating the transceiver, be sure that the microphone plug is removed from the jack or else turn the send-receive switch to receive. If the microphone is left plugged in and the switch is left on transmit, the microphone will continue to draw current even though the transceiver is turned

Important note: Because the HY-75 detector has a directly heated filament, there may in same installations be an objectionable amount of hum in the speaker on receive. If such should be the case, the hum can be reduced to a negligible value simply by utilizing a separate lead and switch for the "A" supply to the Vibrapack. The Vibrapack "hot" lead should go direct to the battery terminal, so that there is no battery lead or switch common to both Vibrapack and transceiver filaments. It is the intermittent drop (due to the vibrator) in a common lead that results in modulation of the filament voltage, the modulation being applied to the grid in the form of varying bias and resulting in hum.

See Buyer's Guide, page 98, for parts list.

The resistor is known by more different names than any other radio component.

A KNOCK OUT



Universal's "KO" model, just out, super microphone value. Ill-output crystal unit. Output level 48 db. below one volt per bar, Freq. range 50-6000 Cl'S, Incl. 10 ft. cable. Accessories enables "KO" to be suspended, as hand mike, or desk or floor stand. \$1625

UNIVERSAL MICROPHONE CO. LTD.

THE "RADIO" NOISE REDUCTION HANDBOOK

Tells in simple language how to eliminate or greatly reduce practically every form of radio noise with the exception of natural static.



Use of the noise-reducing systems described in this book often mean the difference between an unintelligible signal and one which can be read. Particular emphasis is laid on the elimination of the noise at its source. When this is impractical, a new, modification of the noise balancing method used in commercial work, which brings equally

good results, is explained. A complete description, theoretical and constructional, of the application of this method is

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NEW W.A.Z. MAP

The "DX" map by the Editors of "Radio" consists of the W.A.Z. (worked all zones) map which shows in detail the forty DX zones of the world under the W.A.Z. plan. This has become by far the most popular plan in use today for measurement of amateur radio DX achievement.

An additional feature of this new, up-todate edition is the inclusion of six greatcircle maps which enable anyone, without calculations, to determine directly the great-circle direction and distance to any point in the world from the base city for the map in use!

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RADIO 1300 Kenwood Road, Santa Barbara

Non-twisting Geeders for the Rotary

By ED. RIMATHE,* W9TIO

One of the disadvantages of the unidirectional rotatable type antenna is the necessity of incorporating some sort of arrangement to feed the antenna without tangling the feeders when the antenna is rotated through a full 360 degrees. The arrangement used at W9TIO provides a very satisfactory solution to this problem and for that reason should be of interest to those at present using a rotatable antenna or those contemplating building one.

The three-element antenna at W9TIO is of the "revolving pole" type. The 4 by 4 pole and the bottom of the inverted A-frame which supports the elements may be seen in figure 1, which shows the action of the swivel during a 180-degree turn. A more detailed drawing of the swivel itself is shown in

figure 2.

Three pieces of strap iron, a short length of \(^3\)_8-inch pipe and two 5/16-inch bolts about 4\(^1\)_2 inches long are the only materials required for the swivel. The strap iron pieces are of 1\(^1\)_2 by \(^1\)_8 inch stock. Piece A is 6 inches on each of its long sides, or legs of the U, and 4 inches across. As shown in the drawing, 5/16-inch holes through each end of the U act as bearing surfaces. The piece of \(^3\)_6-inch pipe is cut so as to fit between

the open ends of the U, thus holding these ends firmly against the bracket B. This bracket holds the swivel assembly to the pole; it should have two holes drilled in the long side to pass lag screws or bolts running into or completely through the pole.

Piece C, which is the support for the feeders, is a 2½-inch long piece of the strap iron. It has a 5/16-inch hole at the center of the long dimension and near one edge acts as a bearing to allow it to turn when the pole is revolved. Since the feeders used are spaced 2 inches, the small holes in the opposite edge of this piece are likewise spaced this distance between centers. If feeders with wider spacing are used, piece B will have to be longer, of course. With more widely spaced feeders it will also be necessary to make piece A longer than its present 6 inches, to allow the feeders

to clear the pole as it revolves.

In operation, the feeders from the shack to the pole do not turn, but move a small distance horizontally, as well as 5 or 6 inches back and forth. This motion makes it necessary to use springs or a weight at the shack end to keep the feeders taut at all times. The use of springs is illustrated in the drawing. The springs can be of the small, inexpensive variety used for door-closing purposes. A single spring with a bridle arrangement might be used but the two springs

* Slater, Iowa

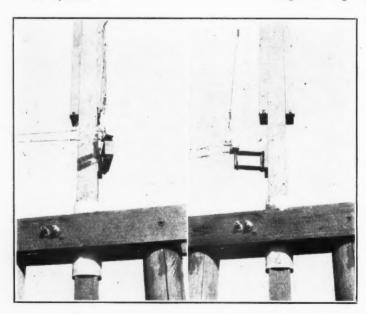
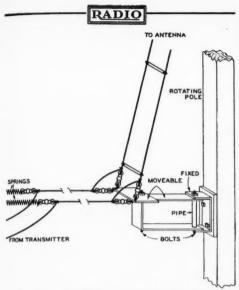


Figure 1. Showing the action of the swivel when the pole makes a 180-degree turn. The antenna is in its extreme clockwise position (looking from below) in the picture at the left and has been revolved 180 degrees in a counter-clockwise direction in the photo at the right. Another 180 degrees in the same direction will bring the feeders around behind the pole, but still in the clear.

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Figure 2. Detail drawing of the swivel and the method of holding the feeders.

will be of material assistance in keeping the feeders from trying to turn over.

A small amount of slack must be provided in the feeders between the swivel and the antenna, since the junction point at the swivel turns through 180 degrees in respect to the antenna when the pole is revolved through the full 360 degrees.

Dotty Dots and Dashes [Continued from Page 44]

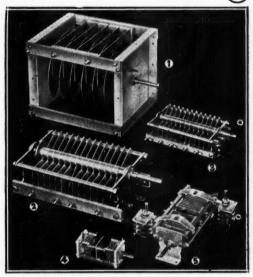
teresting of these is the legend of the development of the Morse question mark. Morse was first recorded on a tape, but the time taken for transposition was great and it was found that the recorder made a certain clicking sound that could be read by an efficient operator. Thus the sounder was developed and break-in was born.

The early operators were almost notorious for their profanity, and inasmuch as many operators were paid by the number of messages sent each day, a missent character brought on a very emphatic "damn" from the receiving operator, followed by the last word received correctly. As time meant money to these ops the "damn" was shortly abbreviated to "dn" (-...), which became recognized as the question mark on all Morse circuits. The sign for the period came about similarly. Originally the word was spelled out, but became shortened until the first syllable became completely lost and only the "ud" remained (..-..), which became the landline period.

How many hams know that the abbrevia-

A HEAdliners IN AN ALL STAR CAST

Each bearing the familiar hallmark of QUALITY, the CARDWELL



OUTSTANDING PERFORMERS, chosen at random, but representing 5 popular groups of transmitting capacitors, widely used in TOP FLIGHT commercial and amateur installations thru-out the world.

(1) 1,000 WATTS and up "P" type, light weight, high power commercial tank tuning unit, 100 mmfd., 10,000 volts peak, 8" x 8" x 10". Mounts readily on any side, with natural foundation for inductance coil mounting on strong folded aluminum end plates.
The safety of the thousands who fly, depends, in part, at least on U. S. Civil Aeronautics Authority radio course beacons, in which the "P" type and other CARDWELLS are used.

(2) 500 WATTS and up "T" type, heavy duty condensers with super-heavy brass frame construction. Without doubt the finest condenser in its class. Like the "P" type, it is built (and used) for 24 hour a day service.

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(4) 50 WATTS and up "TRIM-AIR" dual section midget for portables, U.H.F. transmitters and receivers, Single "TRIM-AIRS" shown as neutralizers on the "AFU", #5 in photo. USED everywhere.

(5) 100 WATTS and up "M" type, MIDWAY FEATHERWEIGHT. Immensely popular with amateurs. Shown here as part of the CARDWELL "AFU" Plate TANK CAPACITOR FOUNDATION unit, nucleus of the PA-240 R.F. POWER AMPLIFIER UNIT. Have you FREE drilling template and Instruction Book? If not, see your dealer.

GET A FREE COPY OF CATALOG NO. 41 and pick out the same ultra-husky, dependable condensers used in the finest commercial and government radio services. SURPRISINGLY INEXPENSIVE.

THE ALLEN D. CARDWELL MANUFACTURING CORPORATION B5 PROSPECT STREET, BROOKLYN, NEWYORK

tions "73" and "88" were used by the landline Morse operators long before Continental was ever used? The numbers 4, 5, 25, 30, 73 and 88 have been used by landline operators almost since the beginning of the art. Who used them first is no longer a matter of record and a number of legends surround their early use. The only ones used extensively by the ham fraternity are the last two, and both of them Even on c.w. we are subjected to abuse. The abbreviation "73" means hear "73s." "best regards," plural. Profanity is prohibited on landline circuits, just as it is on the air, and "88, love and kisses," was the equivalent of "sissy," and implied plenty to any seasoned op-to say nothing of the lids.

This reminds us that the term "lid" is another term borrowed from the Morse fraternity. Its origin also is surrounded with a number of legends, but the one most probably correct is that it is an abbreviation of the word "lifted." If an operator could not "cut the buck" on a hot wire he was taken off, or "lifted," and placed on a "way" wire where the going was not so rough. Consequently an operator that was continually "lifted" became

known as a "lid."

We hams are often tempted to spring on the lid that classic but unofficial abbreviation "QLF?" (Are you sending with your left foot?) But none can compare with the old Morse man's question, "How come you are sending with snowshoes on and with the key screwed to the ceiling?"

Other abbreviations that the hams have borrowed from the Morse men are almost as numerous as the sands of the sea. Looking over a list of abbreviations in any amateur handbook is of little education to any Morse operator. Most of them have been listed in *Phillips Press Code* for years, and if some old timer sends you "asap," calm down. He isn't calling you names; he means "as soon as possible."

112-224 Mc. Hints

[Continued from Page 46]

pink spot at the point where the bulb is nearest to the r.f. In fact, at ten centimeters, the glow is almost all blue. This can be used to detect squeeging and other low frequency parasitic effects in the oscillator. Sometimes, when the rig is adjusted for best output, the neon bulb glows orange, but if the plate tuning is changed slightly, the glow may become pink and blue, and the hum modulation disappears from the carrier.

"and so I chose the 'X-EC'"

This is not an idle advertising caption. Hundreds of hams are saying this every day.

We invite comparison. You will like the "X-EC" for many reasons. You will not be bothered with plug-in coils, nor is it necessary to use any crystals. Yet, for those desiring spot frequencies, provisions are made for the accommodation of three crystals. You will enjoy a new operating thrill when you turn the calibrated dial. It is as smooth as silk and has no backlash. You will be astounded by the stability of the "X-EC." It is equal to crystal in stability and tone. The isolated power supply cannot be overlooked as it is the pulse of the "X-EC." The "X-EC" will work into practically any transmitter. Kilocycle for Kilocycle, Dollar for Dollar, you can't beat the "X-EC."



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"X-EC" HM-103A \$ 4 7 . 5 0

Net . . . F.O.B. Los Angeles Complete with I S O L A T E D power supply, set of tubes, and Licensed by R. C. A.



ASK YOUR DISTRIBUTOR OR WRITE FOR BULLETIN NO. 22

RADIO-TELEVISION SUPPLY CO., INC.
1701 SO. GRAND AVE.

LOS ANGELES, CALIF

Puka Pinnacle

[Continued from Page 12]

birds, and in these the females deposit their eggs. So thickly populated with nests was this section of the island that we were forced to thread our way back and forth to avoid stepping on eggs or setting birds. Arriving at our quarters, I found sleeping space ample and comfortable. Rainfall tapped in tanks is sufficient to provide most of the water supply, and a sun heater contributed warm water for bathing purposes.

From my window the view consisted of a bit of sand spotted with sea birds and a wide segment of sparkling lagoon. Far beyond that was the barrier reef where combers were breaking in silent white explosions, their spray obscuring the horizon. Jutting into the picture in the near foreground was a corner of the building which housed the weather ap-

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This structure we decided would be our shack. A few minutes of conversation had revealed that young Mr. Parnell was hot after the idea of becoming a licensed amateur. Discovering that in his school days he had been a licensed W9, I brought out a ham manual, a set of papers for the class C examination, and promised to give him the exam in two or three days if he'd bone up for it.

To this he agreed at once, deferring studies only until we'd had a talk fest, and it was unanimously agreed that conversation flowed most easily when hands were engaged most busily in setting up a ham rig!

The idea had been buzzing between my earphones throughout the flight, and great was my elation at hearing this Sand Islander name off enough odds and ends of his own to supplement the contents of my junk box.

We set to work feverishly.

The shack was situated on a slightly elevated mound of sand and coral. Total elevation above sea level of this knoll: ten feet! Indeed, the entire island has an average elevation of little more than six or seven feet. Coral, projecting here and there through the sand, was pitted with small depressions or holes. In the Hawaiian language such holes or pits are "pukas" (pronounced "pooh-ka"). Consequently the alliterative location we referred to on the air as our geographical position, "Puka Pinnacle," suggested itself long ago to whoever named the island and charted its elevation, although imagination must have supplied a great part of the "pinnacle."

The building which was to house the pioneer KE6 station was a wooden structure of some 10 by 16 feet. Its corrugated metal roof sheltered a number of weather gauging devices, but there was ample room for the installation of an amateur transmitter as well.



Here we worked through the hot afternoon with a combined collection of misfit parts which needs no further description. The coil of antenna wire now proved worth its weight, and we soon had an antenna erected fairly well clear of the ground and nearly 600 feet long. Its direction was slightly north of east.

In another hour or two we had a low power suppressor modulated rig on the air. Our glee over the first contact should by now be understandable, and so we grinned the incandescent grins referred to at the outset of this article.

Portable KE6 was on the air and would operate all bands when the antenna, with our one "mike" coupling condenser, would load. The station, now with a small tuned r.f. receiver, was complete. Then the fun began!

ceiver, was complete. Then the fun began!

After the W6CQS contact was completed, pandemonium broke loose! Honolulu observers later reported that the band was crowded with stations, but to us it was a horse with a different color, since with the t.r.f. receiver on 14,200 its very broadness seemed to jam all R9 sigs onto one frequency and we could hear just about everybody on 20-meter phone at the same time. As a result, the last R9 station to give his call was the one we were able to contact.

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Later that evening when 20 meters petered out and 80 seemed too crowded after one contact, we shifted to 160-meter phone. About twelve contacts were made on this band, and we gaily subscribed to the theory that this feat must be a record of some kind since operation over 3000 miles of water plus, in some cases, additional land distances gave a few contacts a total of over 4000 miles.

So enjoyably filled were the afternoons and nights with contacts from many mainland friends and from elsewhere around the world that time seemed to have run out of a dump valve. Before I knew it planes were landing on the return flight, and I was saying goodbye to Sand Island and Puka Pinnacle. But only in the flesh, for I left all my gear in the hands of Roger Parnell. Reason: I, too, would like a contact with Johnston Reef, and it is quite possible that this district will be heard from again, since on the day prior to our planes' departure, my associate in this adventure took his examination for the class C amateur license. If his ticket is granted we may all make his acquaintance soon and have another try for a contact from Puka Pinnacle.

(Roger Parnell has received his license and may now be heard on 14-Mc. c.w. signing KE6SRA. Mail should be sent care of the Postmaster at Honolulu.—Ed.)

Postmaster at Honolulu.—Ed.)
There follows a brief summation of data

from the log of K6NYD/KE6:

Worked on 20-meter phone: W1ADM, W2JT, W2IXY, W3FAM, W5VV, W5BB, W6BGW, W6CQS, W7GAE,* W7ACD, W8ROP, W9CVN, W9NDA. Foreign: J2NF, PK4KS, KA1OZ, ES5D, LU4BC, XU8AM... and many K6's including K6BNR, K6MVA, and the home rig with K6MZK at the mike.

On 75-meter phone W5EGR was worked. On 160-meter phone: W5FSQ, W5ADJ, W6PZB, W6PGJ, W6AUZ, W6NYS,

* Charley, it is pronounced "poohka."



1012-14 McGEE STREET, KANSAS CITY, MO.

W6NUR, K6QMC, K6RVF, and due to the kind efforts of W5ADJ signal reports which ordinarily could not have been exchanged due to poor conditions were exchanged with W8SRV, W4ETY, and W9CZN.

On c.w.: W6MUS was worked but reports on the note were not so good. Later, W6OEG

and W1IOZ were worked.

Some stations called that were not worked: W6LXA, W5BIN, W6EIP, W6JJ, W7GFU, W1IED, W6LR, W6KUF, W6MZD, W1JFG, W2HS, W4BMR, W6BMA. Foreign: OA4AI, I1JKV, CE1AH, PY2EA, LU7BK, ES4G, CE2BX.

In five days 125 contacts were made on 3

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What's New in Radio

[Continued from Page 68]

HAND MIKE FOR WIDE APPLICATION

The Turner Co. has released a new, low-cost microphone named the "Han-D" because it is



"Han-D" because it is shaped to fit the hand and also because it is handy for so many purposes. Available in both crystal and dynamic, this fits n e w microphone snugly into the hand, has a hook which allows it to be used as a hanging mike for stage work and call systems, and is designed to fit any standard desk or floor stand with 3/8-27 thread. It is furnished with an 8 ft. cable set, but a 25 ft. set or longer can be furnished. A removable connector is furnished so that cables can be changed or repaired without opening the mike.

A positive contact slide switch affords easy action on the Han-D, and permits the off and on switch to be operated without thumb fatigue. The frequency response of both the crystal and dynamic models is engineered to be suitable for both close speaking (voice application) and for voice and music pickup where the performer is at a distance. Voice reproduction is crisp and clear without unnecessary sacrifice of bass response, yet feedback problems are held

to a minimum.

According to the manufacturer, the Model 9D Dynamic Han-D should be chosen when the microphone will be subjected to extreme heat, cold, humidity, or rough handling, or where extremely long lines are necessary. This dynamic is particularly recommended when the mike is to be used in an automobile. The model 9X Crystal is slightly less rugged than the 9D, yet withstands a great amount of abuse, and gives clear cut per-



LOW PRICED ANTENNA RELAYS by GUARDIAN

★ Low priced, because of modern production methods and volume sales, Guardian furnishes these antenna relays to thousands of radio amateurs.

Famous for ease and flexibility of mounting—famous for compactness and sturdy dependable operation—these Antenna Relays by Guardian give you maximum value at minimum cost.

Tested under actual operating conditions, they have proved capable of handling any power up to a K.W. on any frequency up to and including 28 M.C. on A.F. or R.F. circuits.



Standard A-100 and A-100-C Antenna Relays AlSiMag insulated operate on 110 V. 60 cycle A.C.

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'RADIO" Amateur Newcomer's Handbook

Just published, the "Radio" Amateur Newcomer's Handbook is really two complete books under one cover!



With easy-to-understand data on elementary radio theory (simplified), radio laws and regulations; how to learn the code; how to pass the amateur examination (including typical questions and answers); detailed construction data on simple receivers; a low-powered c.w. transmitter and a be-

ginner's phone transmitter—it contains everything needed to obtain a license and get on the air!

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1300 Kenwood Road, Santa Barbara

RADIO

formance on both voice and music. The output is slightly greater than for the dynamic.

Complete information on these Han-D models may be had by writing the Turner Co., Cedar Rapids, Iowa.

All-Purpose Portable Transmitter

[Continued from Page 37]

phone-c.w. switch S₇, d.c. power socket, audio output socket, and remote control jack.

Figure 6 was taken after a crystal microphone input was installed and therefore doesn't show the microphone transformer. The modulation and filter chokes may be seen clearly and also the bleeder. It could hardly be termed a neat job of wiring, as the photo shows; however, rigidity and efficiency were the two factors as far as we were concerned.

Antenna Coupling

Due to the fact that a makeshift antenna is the usual thing when a person operates portable, we tried to design a versatile coupling arrangement that would still have the benefit of an antenna tuning indicator. When a tuned antenna is going to be used, such as a Marconi or zepp, the link K1 is used. This is the conventional series-tuned system that practically everyone is familiar with. The pilot light is in series with the circuit with a few turns of wire shunting the light to keep it from burning out (L₇). If an untuned type antenna such as a doublet is available, link K₂ is used. One side of the link is brought out to a third binding post and the other terminates on the antenna light shunt about four turns in. It was necessary to tap down the antenna light shunt in this manner to prevent the light from burning out on the higher frequencies. Due to the fact that the antenna coil is so close to the final amplifier coil, only one turn on the link on both the antenna coil and final amplifier coil is necessary (K1). Link K2, however, should have two turns to load properly to some untuned antennas. A number of long-wire antennas were tried on the untuned coupling link, K2, and it was surprising how well some of them loaded up and how good were the reports we received, especially on 10 meters. In one instance an 80-meter zepp was coupled just as though the line were of the untuned variety and the loading effect and reports on 10 meters far surpassed all expectations.

In the 6L6 final amplifier stage all r.f. bypass condensers, C5, C9, C10, are connected direct to the cathode, with the cathode itself bypassed to chassis. This is good practice in any high gain r.f. amplifier and will do more to eliminate parasitics in many instances than

parasitic chokes. There were no parasitics that we could detect in this particular 6L6 stage.

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No cathode bias is used in the 6L6 final stage due to the fact that there was no voltage to sacrifice. However, if another transformer is chosen that supplies more voltage than the one used here a portion of the additional voltage may be used to advantage in the form of cathode bias. Also it would be possible to operate with condenser input and obtain the same results. If cathode bias is used it will be necessary to compensate for the additional bias by reducing the value of the grid resistor R1 and R7.

The complete unit would be adaptable for 5- and 10-meter mobile operation due to its small physical dimensions and rigidity. The outside dimensions of the cabinet are 7x 71/2×14".

Practical 2-Band Rotary Beam

[Continued from Page 27]

one half turns around the master pulley, and at the center of the one and one half turns it should be fastened to the pulley. The cable is then fed over the feed pulleys and dropped down to the operating room.

On the window ledge of the operating room, a 11/2-inch diameter pulley 7 inches long is used with 15 turns of the drive cable taken around this pulley. This pulley (RHM12) can be made by using a piece of shafting 7 inches long and 11/2 inches diameter and having a hole drilled through it to take a ½-inch shaft as it must not turn independently of the shaft, but must be a part thereof. To support the shaft and pulley, two small pillow blocks (RHM14) are mounted outside the window on a board. The 1/2-inch shaft then can come into the room through a conventional under the window lead-in board. A crank handle or small wheel on the end of the ½-inch shaft and the installation is complete. If a pulley is used on the shaft instead of a crank handle, a very light motor with a reversing switch will drive the beam very easily. The cable drive can be made out of heavy clothesline wire. A good suggestion is to use a piece of phosphor bronze cable to make the 15 turns around the small pulley, as it will grip this small diameter pulley much tighter than the stiff clothesline wire. The cable should be pulled taut and no slack or sag permitted, as it is upon the tight and constant pull of the drive cable that the brake of the beam depends. If rope is used, be sure to provide a means of taking up the contraction due to weather changes. Pulley ratios are approximately 15 to 1.

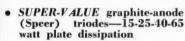
Use a 4 x 4 inch mast for supporting the beam. First mount the shaft and bearings on

FOR THOSE WHO WANT THE BEST

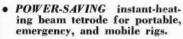
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- HIGH-EFFICIENCY ultra-highfrequency triodes for receivers, transceivers, and transmitters —2½-3½-15 watt plate dissination.
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HYTRONIC

LABORATORIES



A DIVISION OF THE HYTRON CORP

MANUFACTURERS OF RADIO TUBES SINCE 1921











the mast, then bolt the plate or gear to the pulley and the frame through the wood pieces (FW5) with the four 3%-inch bolts (RHM3). Use a hinged bottom on the mast and push it up to the vertical position. The whole assembly can be raised by one husky, and two if needed.

DX

[Continued from Page 56]

the conditions seem to be very fine, if only things were like they "usta" be with all the Europeans Africans, Aussies, Zedders, to say nothing of all the colonies. Yessir, remember when? The last Saturday night of the A.R.R.L. contest 7 Mc. sounded like old times. The Asians were surely pounding through in great style. With conditions like that it would have certainly sounded good to hear those rock-crusher signals come through from the above mentioned parts of the globe. However, let us be content with what we have and by all means let's not stick our neck out in such a way that we W's might lose the chance we have of remaining on the air. Briefly, if we hook up with any station, it doesn't have to be in Europe, let's keep our conversation strictly on the neutral side.

Well, let's see what we can dig out of the mail bag. W9ELX has been active on phone as well as c.w. On phone he has added OQ5AB and KB6CBN making 34 and 89, while on c.w. he

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Call Book Magazine 573

MARCH . . . JUNE . . . SEPTEMBER and DECEMBER

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Single copies \$1.25

RADIO AMATEUR CALL BOOK, Inc. 608 S. Dearborn St. Chicago, Ill., U. S. A.

has 38 and 113. Some of the stuff ELX has worked recently includes KC4USA, XU8AM, KA7FS, PK3BM, KA1OZ, KA4LH, OA4R, PK4KS, CE1AR, KA1CD, KA1CW, YS1MS, KA1LB, HR5C, YN1IP—these on phone. W8CLM adds a few to his honor roll list, KC4USC, HK2BD, HC1VT, and TG9AA making 35 and 99. W2AIW worked XU8MI and of course unless you've heard it before he grabbed AC4YN along about February 18. A word from Henry Jones, W6GCT, indicates he is getting set to be a little more active. GCT was in a terrific auto crackup last year and between you and myself, he has a dx man's luck, and is here to tell us about it.

W2GTZ went slightly berserk on March 23 and worked AC4YN. Reeve says he doesn't think he'll ever be normal again. (I just heard ol' 1492 snicker and say something about no dx man is normal.) Anihoo, this makes GTZ 39 zones and 153 countries. Oh yes, the time was 1325 G.m.t. W6MVK just discovered another zone that had been idle in his log . . U9AC, and this gives him 37 and 118. MVK reports that XU5MK is David Liang, Box 61, Kumig, China, and that XU5MK is coming to the States soon to study at Michigan U. XU8WS has put up an 8JK and likes it fine. W6MVK has a new rig using 75T's with 750 watts input. For the benefit of those who do not know who XF1A is it can be told again here that it is just the same ol' dxer, XE1A/XE2N. I imagine that XF is an official Mexican prefix.

W8NV has been very active on phone and ran up 357,000 points in the recent A.R.R.L. test. George adds a few to his combined total, OQ5AB, KG6NVJ and YS1MS making 35 and 94, while on phone only he has 28 and 65. W8NV uses two rigs both of which wind up with 250TH's in the final. One is on 14 Mc. and the other is on 28 Mc. and each of them works into a 3-element rotary. W4EMV worked KC4USA April 8 and was running only 100 watts to his T55. He

calls his antenna a Signal Pusher.

ON4AU says if any of you fellows have worked any of the ON stations you can send the

W6GRL and W6NLZ work AC4YN

Patience has its rewards they say. This case proves it. On April 18 at 6:00 a.m. p.s.t. Doc Stuart hooked up with AC4YN after two weeks of getting up at 5 a.m. This is to say nothing of the three years of casual gunning for Reg. On the next morning, April 19, W6NLZ worked AC4YN. These are the first two W6's to connect up with Reg, and it shows that it can actually be done. Doc says he was pretty weak but clear enough. The skip at that time for the W6's is screwy, with one antenna working about as good as another. An hour later would be best for the west coast, but apparently Reg is tied up at that time. W9HLF and KB6RWZ are still skedding AC4YN every day they can. Nice going, Doc and Johnny. I guess you won't talk to us now.

cards to him and he will pass them along. ON4AU is having a tough time getting cards out of a flock of stations such as KF6DHW, YA5XX, U8IB, U8ID, J8PG, PK5HL, AC4YN, PJ5EE, YV2CU and FN1C. He says probably AC4YN and YA5XX are NG but it's worth trying.

K7GSC writes from Juneau, Alaska, stating that effective May 1 Southeastern Alaska will go on Pacific Time instead of the former 135th meridian time. Jerry says also that K7AOC has put up a new 3-element rotary, while he himself uses a V with 4½ waves per leg, pointed at

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A letter from Tom Cunningham, VE2JK and VO6D, states that he surely misses the key click across town as well as hearing a certain station working W9's. Tommy says he was checking over his old logs and finds that he had never worked zone 2, and yet he was located there himself for a year. He did work his old pal VO6J on commercial frequencies but that won't do very well for ham counting. Of course you fellows know that when we refer to the above dx men by their calls we realize they are actually ex-hams, but we think it better to call them as we have always known them, rather than to hang an ex in front.

W7AMQ had quite a time in the recent contest and claims his xyl also had a lot of fun supplying him with food, etc. He'll have to watch out in the next contest because with such entusiasm on her part, she will be doing the operating and he will be dishing out chow. Gale added a couple in CX2CO and J8CI, which gives

him totals of 26 and 47, on phone.

W2IXY, Dorothy Hall, has added quite a few to her list giving her a darn good total of 33 zones and 102 countries. As she says, "Remember I am only a yl." I guess a lot of the om's would be glad to do as well. W3KT has been gunning for a long time for an OQ5 as he needs that zone badly. He has revised his country total by dropping a VU and ZP which proved to be NG. This gives Jesse 37 and 104 . . . almost forgot to say he added one which helps, this one being I&CG.

being J8CG.

W5VU from Dallas just got up his rotary in time for the contest, and it netted him about 602,000 points on phone. Here are some of his recent and their frequencies: J2CS, 14,210; J2NF, 14,175; J5CW, 14,080; J2XA, 14,090; J7CB, 14,060, J2NG, 14,070; J2NQ, 14,070; XU8AM, 14,092; PK4KS, 14,040; PK3GD, 14,030; PK3JK, 14,120; PK3BD, 14,035; PK1JR, 14,040; KA1ME, KA1LB, KA1FH, KA4LH, KA1OZ, KA1JH, all between 14,100 and 14,150.

W7AYO is heard from again. Stan was on in the contest to the tune of 350,000 points. He didn't have much time but had a lot of fun anyway. W6ITH has upped his phone total to 36 and 99, while on c.w. and phone it goes to 37 and 105. The new ones were YS1MS and KC4USA. W6FHQ has worked KC4USA for their first W6 contact. He also worked XU8AM; XU5TH, 14,090; PK1VM, 14,070; PK1OG, 14,070; and XU0A. Barney says if XU0A is in zone 23, what is there left to work? FHQ uses a 3-element rotary of his own and it seems to do very nicely.

W8LFE grabbed his key long enough to land TF5C for his 38th zone and 113th country. We hear that W9EQG from Chicago is on his way to California for keeps. He and the xyl appear

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to be moving out, mebbe to try a California kw., although I always thought 1000 watts was 1000 watts anywhere. W6MUS has YS1MS and UK9AN which gives Neil 36 and 84. W3BET reports some 14-Mc phone dx which he has been working: HA7P, 14,260; I1TAK, 14,095; I1RE, 14,145; XU8AM, 14,090; PK1OG, 14,050; KC-4USA, 14,150; HA1O, 14,020; K7HAR, 14,185; K6PLZ, 14,200; ES5D, 14,025; OA4R, 14,030; CE1AR, 14,015; YS1MS, 14,110; PK2AY, 14,040.

W1AKY landed three new ones in the contest: KF6JEG, ZP3AC, and YS1MS. This totals to 31 and 92 on phone for Ed. W6DLY has received his card from U9BC which will show this one to be OK. U9BC is in zone 18, making DLY 37 zones and 97 countries.

Whoever ON4A is has been telling the gang to send their cards to me and that I knew where to send them to him. I haven't as yet heard from ON4A but it's all right with me to continue sending them and if I ever do hear, they will be passed along. I hope you fellows will get all primed for RADIO's contest in October. The next issue will be the last one before the summer layoff and you will have the summer to get in trim for the "ordeal." As stated before, this next number, July, will contain all the rules for the brawl. Last November and December when we staged the first one things were pretty much on the dull side of dx, but I believe that there is considerably more activity now than then. Conditions should be better also. Last December the shack looked more like a club meeting most of the time, as is always the case here during a test. It seems to be a signal for the fellows to gather at the shack. Anyway, it was a lot of fun and a couple of the fellows pounded a little brass which added a few points to the total. W6OEG, who will be remembered as helping in the pickup of the Honolulu yacht race, was on deck and

surprised everyone by staying awake until midnight one night.

When Roddy, W1SZ, was out here last week he saw quite a lot of "power" for one evening. They were called "Zombies." Just ask him to have a third sometime. Says he, "This must be the so-called California kilowatt." I also introduced him to a W9, just to prove my contention is no myth.

W60EG, W9ARL and W6QD Bag AC4YN

This is one time when I don't think you will object to your dx ed. giving off steam. Well, you see it happened like this. Having a restless night yours truly decided to get up at 5:30 a.m. and take a look around the band. Asia in general was coming through like the very deuce . . . so tun-ing up to AC4YN's frequency (14,292) who should I hear but Reg tossing out a lusty CQ. He was so good I thought it was a gag, so just sat paralyzed. After 5 minutes he gave out another one and by this time I was fully awake. The key durned near jumped off the desk, but after grabbing it and punching away for a minute, AC4YN came back. The rest is now history. except that right after our QSO good ol' W6OEG nabbed him in the best sneaker he has pulled yet. It will remain a mystery as to how Bill got up so early . . . because I haven't seen an alarm clock yet that will disturb him. I guess he just doesn't tell all. A little later in the morning W9ARL related how he had just finished his new rotary beam in the afternoon and the very next morning he snagged AC4YN . . . with a 589 report. Johnny believed in starting with the best contacts and working down. Anyway I'm glad the ice has been thoroughly cracked for the gang to get a whack at AC4YN. The W6's have been getting it on the chin long enough. Ouch!!

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RECONDITIONED guaranteed receivers and transmitters. Practically all models cheap. Free trial. Terms. List free. SX-23s \$89.00. W9ARA, Butler, Missouri.

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SELL—Stancor Twenty P. Transmitter. Also fifteen watt speech amplifier. W9QJB.

WANTED-HRO Senior for cash. State condition. W4FZW.

West Gulf Division Convention

The 14th Annual West Gulf Division A.R.R.L. convention will be held in Fort Worth, Texas, June 28 and 29, 1940, with the Kilocycle Club as host. The Blackstone Hotel has been designated as headquarters. Convention Executive Committee consists of R. E. Cowan, Jr., W5GKA, R. R. Stegall, W5ELC and A. B. Dobbs, W5FJP. The Kilocycle Club is being assisted by the Dallas Radio Club, and present plans contemplate the finest and most elaborate convention ever to be held in the West Gulf Division.

Roanoke Division Convention

The Roanoke Division of the A.R.R.L. is planning a convention to be held August 3 and 4, 1940, at Chamberlin Hotel, Old Point Comfort, Virginia. Captain Edmund C. Lynch, W3HWJ, is in charge of the program. Due to the popularity of the convention location as a vacation resort, the committee is emphasizing the bathing, deep sea fishing and other attractions of the area. The program will be light on heavy material and heavy on pleasure.

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Buyer's Guide

Where to Buy It

PARTS REQUIRED FOR BUILDING EQUIPMENT SHOWN IN THIS ISSUE

The parts listed are the components of the models built by the author or by "Radio's" Laboratory staff. Other parts of equal merit and equivalent electrical characteristics usually may be substituted without materially affecting the performance of the unit.

WALLER REMOTE CONTROL CIRCUIT

Page 13

Z₁, Z₂, Z₃—Guardian Series 60: 2000-ohm coil, type A3 contacts
 Z₂—G.18597 Guardian S-120 stepping relay, 200-ohm coil, A2 contacts

DAWLEY AUDIO OSCILLATOR

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C_{1A}, C_{1B}—Radio Condenser Co., 4 gang. C₂, C₂—Solar MW-1216 C₄—Solar S-0257 C₅—Solar S-0263 C₆—Solar S-0240 C₇—Solar DAA-708 C₈, C₁₀—Solar D-820 1/2 and 1 watt resistors—Centralab 516, 710, and 714 10-watt resistors—Ohmite Brown Devil S₁—Yaxley 3226J T₃—Thordarson T-57S01 T₂—Thordarson T-13R11 CH—Thordarson T-13C28

SMITH 112-MC. TRANSCEIVER

R-GE Mazda no. S6

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C1—Cardwell ZV-5-TS with mounting bracket (discard 2 segment stator and substitute regular stator plate). A type A insulated coupling is used with the condenser.

C2—Sprague 2FM-31

C3, C4, C5—Sprague type TC

C6—Sprague UT-8

C7—Sprague TA-10

R2, R3, R4, R5, R10—Centralab 710-714

R1, R7—Sprague 5-K

R5, R6—Mallory-Yaxley type L

R9—Mallory-Yaxley Y-50-MP

RFC—Ohmite type Z-1

S1—Centralab type 1450

T1—Thordarson T-72A59

T2—Thordarson T-13S38

Bat.—Burgess "Little Six" Pwr Pack—Mallory VP-552 Vibrapack

STRIKER PORTABLE TRANSMITTER

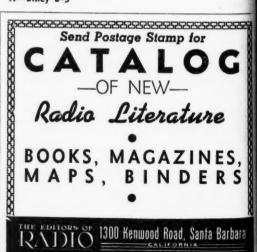
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C₁, C₂, C₃, C₄, C₅—Aerovox 1131 C₇—Hammarlund Star SM-50 C₈—Hammarlund Star SM-100 C₉, C₁₀—Aerovox 1450 C₁₂—Bud 911 C₁₇—Hammarlund MC-200-M CH₁, CH₂—Thordarson T-13C30 S₁—Centralab 1460 Cabinet—Bud #-995 Chassis—Bud CB-1194

DRIML 28-MC. MOBILE TRANSMITTER

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C₁, C₂, C₃—Hammarlund type APC Midget mica condensers—Aerovox 1467 C₁₁—Aerovox PRS-25 Carbon resistors—I.R.C. type BT B—Burgess 2Z2SC X—Billey B-5



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